

Stone and water in sound:
A composition portfolio informed by the natural growth processes
of stalactites and stalagmites

PhD thesis

(75% portfolio; 25% commentary)

Andrea Granitzio

Submitted in partial fulfilment of the requirements

for the degree of Doctor of Philosophy

at Royal Birmingham Conservatoire

Faculty of Arts, Design and Media

Birmingham City University

October 2017

Abstract

This doctoral research has two main goals: to create a collection of compositions exploring the potential of the Sounding Stones, both as a solo instrument and as a new resource to enrich orchestral timbre, and to compose a large-scale work for orchestra, building on the relationship between water and stone as they converge within the natural processes of stalactite and stalagmite growth. A second larger-scale piece accompanies the orchestral one, to show additional interactional scope between the Stones and traditional instruments.

This composition portfolio consists of two larger works and seven supplementary pieces. The major work is *Speleothemes*, comprising four movements:

I. 'Stalactite'

II. 'Stalagmite'

III. 'Joint' and

IV. 'Before'

The accompanying commentary analyses all the compositions within three categories, namely:

- Compositions for Stones
- Compositions for Stones and small ensemble
- Composition for Stones and orchestra

This commentary also examines the aesthetic issues and technical considerations involved in creating the works.

Table of contents

Abstract	ii
List of figures	vi
Acknowledgements	viii
Introduction – Methodological syncretism	1
0.1 Research questions, aim and objectives	2
0.2 Overview of composition portfolio	3
0.3 Overview of commentary, including summary of chapters	3
Chapter 1 – Research context	6
1.1 Found objects in musical composition	6
1.2 Pinuccio Sciola (1942–2016)	11
1.3 Origins, time and nature	12
1.4 Stones and sound	13
1.5 The Sounding Stones	15
1.6 The Sounding Stones in my compositional practice	17
Chapter 2 – Integration between modal jazz, classical contemporary music and improvisation	19
2.1 George Russell and the <i>Lydian Chromatic Concept of Tonal Organization</i>	19
2.2 Toru Takemitsu and the Lydian Concept	21
2.3 Degree of improvisation	23
Chapter 3 – Interdisciplinary approach: Chinese musicology, Geosciences and Neurosciences	25

3.1	Chinese musicology	25
3.2	Geosciences and Speleology	28
3.3	Neurosciences	30
Chapter 4 – Preparatory works		32
4.1	Compositions for Stones: aims and functions	32
4.11	Collection of works: <i>Heaven’s Gate, Erinni, Stonature, Heart of Stone</i>	33
4.12	<i>Pangaea</i>	36
4.2	Compositions for Stones and small ensemble	40
4.21	<i>Time Persistence</i>	41
4.22	<i>Octahedron</i>	43
Chapter 5 – <i>Speleothemes</i>		50
5.1	Etymology of speleothem and <i>Speleothemes</i>	50
5.2	‘Stalactite’	51
5.3	‘Stalagmite’	61
5.4	‘Joint’	68
5.5	‘Before’	75
Chapter 6 – <i>The Fluid Mosaic</i>		81
6.1	Conceptualisation and structure	81
6.2	Techniques and notation	82

Chapter 7 – Conclusion	84
7.1 Response to research questions	84
7.2 Further reflections and future possibilities	89
Appendix 1 <i>Stone Book</i> (USB drive)	91
Appendix 2 Notation glossary	92
Appendix 3 Selected compositions (USB drive)	110
List of references and resources	111

List of figures

- I: Limestone Sounding Stone – ‘Keyboard’ (photo: Andrea Granitzio).
- II: One-row basalt harp (photo: Granitzio).
- III: George Russell’s example of the Primary Order of the Lydian Scale (Russell, 1953, p. 2).
- IV: Example of pitch material of second viola and first violin from *The Dorian Horizon* by Toru Takemitsu (Burt, 2002, p. 102).
- V and VI: Images of Qing, Forbidden City, Beijing.
- VII: Transcription of *Heart of Stone*, main theme as played by Pinuccio Sciola.
- VIII: Granitzio, *Time Persistence*, Sounding Stones notation and score instructions.
- IX: Granitzio, *Octahedron*, G Lydian Augmented groups, flute, first exposition.
- X: Granitzio, *Octahedron*, C Lydian Augmented groups, violin I, first exposition.
- XI: Granitzio, *Octahedron*, sequences of groups’ scheme.
- XII: Granitzio, *Octahedron*, scheme.
- XIII: Granitzio, *Octahedron*, flute, cello and stone trio ‘cercando il dialogo’ – seeking dialogue.
- XIV: Granitzio, *Octahedron*, flute, cello and Stone trio, notes above and below the central pitch.
- XV: Granitzio, *Octahedron*, instruments on stage.
- XVI: Granitzio, *Octahedron*, improvisation notation.
- XVII: Educational signs in the Luray Caverns in Virginia to promote public understanding of the difference between stalactites and stalagmites.
- XVIII: Granitzio, ‘Stalactite’, progressive alterations of the Lydian scales.
- XIX: Granitzio, ‘Stalactite’, first impact, G Lydian + G Lydian Augmented alterations.
- XX: Granitzio, ‘Stalactite’, second impact, G Lydian Diminished + Lydian Flat 7.

- XXI: Granitzio, 'Stalactite', third impact, G Lydian Auxiliary augmented + G Lydian Auxiliary diminished + Lydian Auxiliary diminished blues.
- XXII: Granitzio, 'Stalactite', table illustrating the impacts of the first drop on the ground.
- XXIII: Granitzio, 'Stalactite', manuscript scheme outlining 'Stalactite's structure and the roles of every instrument relating to the thematic 'outgoing' development.
- XXIV: 'Stalactite', *Helictites stalactite*.
- XXV: Granitzio, 'Stalagmite', contrabassoon first sequence, proportional notation.
- XXVI: Granitzio, 'Stalagmite', table illustrating the complete sequence, where So.St. indicates Sounding Stones.
- XXVII: Granitzio, 'Stalagmite', manuscript scheme illustrating the horizontal spiral on stage.
- XXVIII: Granitzio, 'Stalagmite', vertical spiral on stage.
- XXIX: Granitzio, stalagmite, Ardèche Caves, France (photo: Granitzio).
- XXX: Granitzio, 'Joint', table overview of the theme's development according to the 'outgoing' Lydian notes.
- XXXI: Granitzio, 'Joint', C descending theme – seven Lydian scales, plus first two combinations (L + LA and LD + LF7).
- XXXII: Granitzio, 'Joint', C descending theme – last combination (LAA + LAD + LADB).
- XXXIII: Granitzio, 'Joint', G ascending theme – seven Lydian scales, plus first two combinations (L + LA and LD + LF7).
- XXXIV: Granitzio, 'Joint', G ascending theme – last combination (LAA + LAD + LADB).
- XXXV: Granitzio, 'Before', ideal sound spatialisation in a large theatre, hall or gallery.
- XXXVI: Granitzio, *The Fluid Mosaic*, bowing notation.
- XXXVII: Granitzio, *The Fluid Mosaic*, hands notation.

Acknowledgements

I would like to thank all those who accompanied me throughout this musical journey.

My supervisors:

- Prof. Lamberto Coccioli, who has always supported me with enthusiasm and constructive criticism, pushing me to broaden and deepen my interdisciplinary approach to music and who gave me the opportunity to further my musical experience by facilitating a visiting research project in China.
- Edwin Roxburgh, a guiding light, whose constant inspiration and support underpinned the aesthetical basis of this work, and who incessantly encouraged me to persevere in finding my own personal and original way to conceive music (*'We must never be defeated'*).
- Prof. Deborah Mawer (Director of Studies), for continually helping me to remain within the boundaries of my research project, and patiently supporting the academic path I had begun with Prof. Chris Dingle.
- Prof. Joe Cutler and Dr Michael Wolters, with whom I started my musical journey at Birmingham Conservatoire.
- Prof. Johnny Golding, for introducing me to her inspiring circle of Philosophy and Radical Matter in Art.
- Andrea Cox, for supporting me every time I needed help at the Conservatoire.
- Prof. Zou Xian Ping and Fang Fang, with whom I shared a truly inspiring and intense experience in Chengdu, at the Sichuan Conservatory of Music.
- Sebastiano Dessanay, who took primary responsibility for enabling my studies at

Birmingham Conservatoire, and with whom I shared the greatest part of my life as a researcher during my permanence in Birmingham.

- Daniela Pani, with whom I shared a unique friendship with Pinuccio Sciola, and who acted as a priceless mentor in the field of geoscience, introducing me to the underworld of caves and listening untiringly, on innumerable occasions, to my flights of fancy about music and speleothems among Italy, England, Iran and China.
- Arrigo Cigna and Giovanni Badino with whom I shared respectively my first experiences of the International Geosciences Congress, in Iran, and of the Eurospeleo Congress in the UK, and who offered new perspectives on music and science.
- My 'sister' Veronica Ghiglieri who acted, among many other things, as the creative mind behind the NeuroStones project.
- Jacopo Cullin and Andrea Aru, for their help and professionalism in realising *Stone Book*.
- Louise Marongiu, for her constant presence, help and support during the last, not always easy, years.
- Steve and Sue Sandys, my 'English parents', for their kindness and support.
- My Mum and my brother Fabio, the true geoscientist in our family, as well as Anna, Matilde and Lorenzo.
- To those who will listen to the music I composed from a different place, my father Antonio Granitzio, my grandfather Pinuccio Fanni and my 'brother' Andrea Marongiu.

This work is dedicated to the memory of the artistic father of my research, Pinuccio Sciola, the man born of stone, with whom I had the privilege to spend time, talk and walk on this Earth.

Introduction – Methodological syncretism

My musical educational path in Sardinia and the United Kingdom was characterised initially by classical music studies and the development of a keen interest in French music of the early 1900s, especially the piano and orchestral music of Debussy and Ravel (see List of References and Resources below). Subsequently my attention was drawn to the languages of jazz improvisation and contemporary music, with a special focus on the practices of George Russell and Toru Takemitsu, situated within a broad musical landscape that also includes composers such as Halffter, Holliger, Ligeti, Murail, Saariaho and Thorvaldsson (see again List of References). Moreover, my cultural background was characterised by an education in the humanities including a degree in law, with a particular interest in the philosophy of law. This led me to develop a methodological approach, allowing the identification of the main general legal principles to be applied to different cases, and, consequently, to find a way to reconcile any conflict. I also had a childhood passion for malacology and the marine world; more recently I have been interested in speleology and the underground world.

Thus it was a natural progression for me to seek an integration between all the influences that have piqued my interest and subsequently to focus my attention on those artists who have linked the worlds of water and stone (for example, Gaudi), and the artists who have linked these natural elements with music (for example, Debussy, Ravel for music and water, and Pinuccio Sciola for music and stone). Water, stones and sound, defined in all their possible articulations, are the three keywords converging in my research. Driven by the interest to find a relationship that could inextricably bind and unite all three elements – water that turns into stone, converging into music – I thought of a natural phenomenon that combines water and stone: the growth of stalactites and stalagmites.

This phenomenon perfectly embodies the concept behind the word syncretism: the process by which phenomena and concepts that may initially appear in irreconcilable conflict converge, due to conceptual, semantic and etymological similarities. Stalactites and stalagmites are physically and symbolically at the antipodes, as they are the result of the combinations of two opposite elements: liquid state (water) and solid state (stone). It happens in limestone caves, where the slightly acid water dissolves some of the limestone, carrying it downward, literally turning drops of water into stone. Therefore what may appear as a contrast – an antithesis – between liquid and solid states is reconciled and brought back into union, in a sort of geological syncretism, in which water and stone act independently with their distinct roles but also in a reciprocal interaction, both involved in the formation of speleothems: living organic forms in constant development. Within this framework Pinuccio Sciola's limestone sounding sculptures represent a quintessential synthesis of water, sound and stones, overcoming semantic obstacles and recomposing the antitheses between apparent opposites.

0.1 Research questions, aim and objectives

Throughout this thesis I have sought to explore the musical interaction between the Sounding Stones and the orchestra, addressing the following research challenges and questions:

- How can the timbral spectrum of the Sounding Stones enrich the language of composers?
- Can the Sounding Stones successfully become part of an orchestral instrumentation?
- Is it possible to integrate different influences as modal jazz and classical contemporary music, into an original and effective compositional outcome?

- How can improvisation be integrated within this kind of compositional approach?

For the purposes of my research, I focused upon three key areas:

- Timbre and the identification of the sound produced by the Sounding Stones.
- The relationship between the use of modes made by George Russell and its subsequent development in Toru Takemitsu's music.
- Improvisation and the interaction between the orchestra and the Sounding Stones.

0.2 Overview of composition portfolio

The portfolio consists of a major work, *Speleothemes*; a second larger-scale work, *The Fluid Mosaic*; and seven supplementary works, including five pieces for Sounding Stones, and two compositions for Sounding Stones and small ensemble. In addition, a USB drive entitled *Stone Book* supports the portfolio. This USB drive features a substantial number of short videos showing all the techniques developed so far for playing the Sounding Stones.

0.3 Overview of commentary, including summary of chapters

This commentary discusses and illustrates the research issues explored in the portfolio, with the purpose of giving an understanding of the concepts, inspirations and approaches within the music. It consists of five chapters. Chapter 1 ('Research context') provides a presentation on so-called 'found instruments', their integration and their function within music composition during the last century, together with an introduction to the Italian sculptor Pinuccio Sciola (1942–2016), his artistic path and his aesthetics. An overview of the relationship between sound and stones, and a presentation of the Sounding Stones, aims to offer a precise contextualisation for my own compositional process.

Since this portfolio focuses on the integration of different influences, from modal jazz to contemporary classical music and improvisation, with the aim of binding them into an original and effective compositional outcome, the second chapter ('Integration between modal jazz, classical contemporary music and improvisation') examines how I have combined and have been inspired by those three elements in my compositional process. It comprises the following topics: George Russell and his *Lydian Chromatic Concept of Tonal Organization*; *The Dorian Horizon*: Toru Takemitsu and the Lydian Concept; and, finally, integration between improvisation and notated music.

The third chapter ('Interdisciplinary approach') examines how interdisciplinarity informed both my aesthetics and my compositions; it involves my interests in Chinese musicology and its traditional approach to stones; geology, geophysics and speleology; neurosciences. The fourth chapter ('Preparatory works') describes the methodological approach used to address and overcome the issues and technical problems encountered when composing with the Sounding Stones. It illustrates the steps of my research journey on Sounding Stones, passing through two main phases: solo compositions for Sounding Stones; and compositions for Sounding Stones with small ensemble. The culminating fifth chapter (*Speleothemes*) focuses on the analysis of the main work for Sounding Stones and orchestra, and is divided into four subsections that mirror the movements: 'Stalactite'; 'Stalagmite'; 'Joint'; and 'Before'.

An important part of the underpinning doctoral research focused upon defining a technique to play the Sounding Stones, so that, through a codified (un)conventional music notation, they could be used as proper instruments with the potential to extend and enrich orchestral sound. Half of this work was undertaken in collaboration with Pinuccio Sciola because he had in his workshop Stones of different sizes and different pitch series, and also because, besides being the author of the sounding sculptures, he was the first to discover

their potential. The other half was achieved through my own further experimentations with the Stones that he had entrusted to me, and that I brought over to Birmingham Conservatoire.

The results of this research are documented in a USB drive entitled *Stone Book* (Appendix 1), which includes 48 videos showing all the techniques developed so far, most of which have been used for the purposes of composing the works included in my portfolio. All videos were shot at Sciola's house in Sardinia, with the Sounding Stones played both by him and myself. This USB drive, together with the Notation Glossary (Appendix 2), aims to provide a handbook for those who would like to perform the Stones, and as a starting point for those who would like to deepen their study and, hopefully, develop further new techniques. Audio recordings of selected works from the composition portfolio are included as Appendix 3.

Chapter 1 – Research context

1.1 Found objects in musical composition

Given that the whole thesis (commentary and composition portfolio) relates to creating music using Sounding Stones, derived from natural resources and landscape settings, this opening portion of Chapter 1 aims to provide a definition of ‘found instruments’, and an overview of their role and function in the compositional practice of several composers during the twentieth century. According to *The Grove Dictionary of Musical Instruments* (second edition), a ‘found instrument is a term used loosely for a sound-producing or sound-modifying implement made of something either occurring in nature or originally fashioned for another purpose ... local environments influence artificial sound production’ (Libin, 2015). Environment, thus, plays an important role in instrumental historical development:

from the Magdalenian period, some 12,000 years BP, the caves themselves, where not only were stalactites struck but the caves themselves were used as resonators for sounds; both Lucie Rault and Lya Dams have brought together a number of convincing reports of this (Dams, 1985; Rault, 2000). Resonant stones must also have been struck outside the caves, the so-called rock gongs, boulders struck on resonant points, and these are of unknown antiquity but many bear well-worn cup marks on their surfaces. Rock gongs were first reported by Bernard Fagg in Nigeria, and following his article (Fagg, 1956), many more have been reported from around the world (Fagg, 1997). (Montagu, 2017, n.p.).

The twentieth century has been characterised by rapid industrialisation and, subsequently, by a technical improvement, which gave rise to new inventions, including

new material to combine with previous sources. This revolution influenced many different artists, including painters and composers, the latter benefitting from a huge sonic expansion to be incorporated in their work in the form of everyday sounds. Already in 1917, while composing the music for Diaghilev's ballet *Parade*, Erik Satie (1866–1925) was influenced by the surrounding urban environment, together with the sound and indeed noise of 'objets trouvés' ('found objects'). He scored the work for orchestra and typewriter, siren, revolver and a lottery wheel, aiming to merge more conventional orchestral sounds with the noise of the cities.

This role of noise was legitimised and celebrated by the Futurist movement in a manifesto published by *Le Figaro* in 1909, signed by the writer F. T. Marinetti (1876–1944). Later on, the painter Luigi Russolo (1885–1947) joined the Futurists, proclaiming: 'We must break at all cost from this restrictive circle of pure sounds and conquer the infinite variety of noise-sounds', in his significant contribution entitled *The Art of Noises* (1913, p. 7). Russolo conceived the *Intonarumori*, probably the first instrument created with the aim of reproducing everyday urban noise, consisting of a series of 'noise generators' (Stock, 1994: p. 15), assembled with 'wooden and metal wheels of varying shapes', together with a vibrating 'metal string attached to a drumhead to transmit vibrations to the speaker' (Saggini, 2013; quoted in Stock, 1994, p. 16). Russolo not only conceived a notation for his instrument, but also performed his composition *The Awakening of the City* in several theatres in Italy and in London. According to Robert Morgan, Russolo's aesthetic and functional approach 'respond[ed] to a series of abandonments: monotonicity in Wagner, the triad in Scriabin, tonal centricity in Schoenberg, metrical rhythm in Stravinsky. Having reached the zero degree of form, the art of music gives way to the art of noise.' (Morgan, 1994, p. 143).

Such influence of everyday urban sound characterised the early compositional

approach of Edgard Varèse (1883–1965), who used to explore a Parisian flea market seeking out whistles and noise makers. Varèse stated: ‘I began listening to the sounds around me from all directions and imagined how such sounds, and in just such complexity, could be transmuted into music’ (Varese and Alcopley, 1958, p. 195). Particularly attracted by the sound of sirens, since he was in his twenties, Varese claimed that he was impressed by how he ‘could obtain beautiful parabolic and hyperbolic curves of sound which seemed to me equivalent to the parabolas and hyperbolas in the visual domain. Much later, I used sirens as musical instruments in three of my scores, in 1922 in *Amérique*, in 1923 in *Hyperprism*, and again in 1932 in *Ionisation*’ (Varese and Alcopley, p. 194).

The aim of integrating everyday sounds with those that Copley called the ‘old instruments’, in tandem with the hope of using some new musical apparatus, constituted ‘the metamorphosis of sounds into music’ (Copley, 1968, p. 195). This approach distinguished Varèse’s aesthetics from those of the Futurists. Varèse distanced himself from Marinetti and Russolo’s manifesto, maintaining that, whilst Futurists believed in reproducing sounds literally (‘Why Italian Futurists, have you slavishly reproduced only what is commonplace and boring in the bustle of our daily lives?’, Wen-Chung, 1966, p. 11), he dreamt instead of new devices: ‘instruments obedient to my thought and which with of a whole new world of unsuspected sounds, will lend themselves of my inner rhythm’ (Wen-Chung, 1966, p. 11). He imagined being able to compose with ‘sounds of any number of frequencies’, whose function would have been the ‘liberation from the arbitrary, paralysing, tempered system’ (Wen-Chung, 1966, p. 12), ‘making available to composers all the new sounds of our time with their rich emotive potential’ (Copley, 1968, p. 195).

An analogous attitude to everyday sound pushed the young Pierre Schaeffer (1910–95) to ‘the sound effects department of the French Radio service’, in search of ‘doorbells, rattles, an alarm clock, whirligigs, and a variety of bells’ (Stock, 1994, p. 30), with the aim of

creating a 'Symphony of noises'. Schaeffer's aesthetic roots were based on the idea of overcoming the original function and meaning of the sound, connecting sound fragments whose coherence and integrity would be re-organised in a musical way by those who would listen to them as music. 'So, for there to be music, all that is needed is that a relationship be established between subject and object, and the initial act in music is willed hearing' (Schaeffer, 2012, p. 66). This conception probably offered contemporary and future composers the widest perspective on the use of everyday environmental sounds and material.

Among these contemporaries, John Cage (1912–92), who studied counterpoint, form and analysis with Arnold Schoenberg, developed an acute interest in percussion music and the use of noise and unconventional 'instruments', such as flowerpots, automobile brake drums, 'thundersheets' and beer bottles, in musical composition (Williams, 1998, p. 58). The young Cage had been initially influenced by the film-maker Oscar Fischinger who talked to him 'about the spirit which is inside each of the objects in this world. So, he told me, all we need to do to liberate that spirit is to brush past the object, and to draw forth its sound. That's the idea which led me to percussion.' (Williams, 1998, p. 56). Cage had also been influenced by Russolo's *The Art of Noises*, which he later 'quoted' in his own manifesto, entitled *The Future of Music: Credo* of 1937, stating: 'whereas, in the past, the point of disagreement has been between dissonance and consonance, it will be, in the immediate future, between noise and so-called musical sounds' (Cage, 1961, p. 3).

This background led Cage to explore new sound possibilities, with the prepared piano and with electronic devices, as happened with the cycle *Imaginary Landscape*, directed by the compositional goal 'to allow sounds to be themselves, unhampered by the stringent laws of harmony and tonality' (Williams, 1998, p. 60). This yearning for freedom of choice was reflected in other compositions, especially *Living Room Music* (1940), where the

performers were free to choose found instruments in a living room, but also in the *Quartet for Percussion – No Instruments Specified* (1935), which left musicians absolutely performing inventiveness (Williams, 1998, p. 60).

All the facets of this musical experience, the interest in found instruments, in environmental natural sounds and indeterminacy, converged in *4.33* (1952), probably the peak of Cage's musical evolution. This now infamous piece was conceived to allow its audience to listen to the environmental sound and 'to make available to music any sound that could be heard, whether or not that sound was considered "musical"' (Williams, 1998, p. 61). According to Kyle Gann (2010, p. 25), 'it would be Cage who made the most radical turn toward nature of any composer: nature as associated with chance and environmental sounds.'

The need to move beyond the predetermined frame of tonal music, distinguished the whole artistic path of Harry Partch (1901–74), who 'dedicated most of his life to implementing an alternative to equal temperament, which he found incapable of the true consonance [that] his ear and essentially tonal aesthetic demanded' (Kassel, 2001, n.p.). To match his own compositional ideas, he customised, or personalised, traditional instruments (for example, the Adapted Viola). Similarly, he designed and built his own series of instruments that were often created using natural materials, like the *Bamboo Marimba II*, made entirely from mottled Japanese bamboo, or the *Quadrangularis Reversum*, whose sides were created from natural branches of eucalyptus. His creations allowed him to develop a microtonal – natural – tuning system as he theorised in his book *Genesis of a Music* (1947), so 'opening new doors towards what he called "meaningful adventures in dissonance" ... by rationalizing a set of pitch resources first and then composing music with them' (Gilmore, 2003, p. 18).

A step towards an integration between found-sound and compositional practice is

represented by *Different Trains* (1988) by Steve Reich (b. 1936), a piece based on surrounding sounds and speech taken from a train-trip environment. Instead of being considered 'external' elements to be included and merged with other instruments, found-sounds were turned into an original source of sound: 'All the melodies in the piece were basically taken just the way you take melodic dictation, only I was taking them from people's voices. As they spoke, so I wrote; they gave me the notes, they gave me timbre, they gave me tempo, and they gave me meaning' (Reich, as quoted by Schwartz, 1996, p. 96). This approach supported an evolution that overcame the distance between traditional and found instruments in composers' practice and which results in scoring '*for* found sounds, with pitch, rhythmic, and textural details deriving solely from the acoustical attributes of the recorded everyday sounds' (Stock, 2014, p. 55).

This then is the broad historical and aesthetic context for an approach to composition which looks to the natural found element of stone, sometimes actively created within cave systems (see below), as a crucial resource that is then sculpted into a unique and precious instrument, by human hands: in this case, those of Pinuccio Sciola.

1.2 Pinuccio Sciola (1942–2016)

I knew Pinuccio Sciola by reputation since I was a teenager, as he was one of the most important Italian living sculptors and Sardinian intellectuals, but I only met him by chance in August 2011, in the corridors of Sardinia's Regional Urban and Landscape Planning Department, where I used to work as a legal civil servant. Due to his renowned career, he had just been nominated President of the Commission for Sardinia's Regional Landscape and Architectonic Quality. After introducing myself, I briefly told him that I was aiming to compose a piece for orchestra integrating the sound of his sounding sculptures (a project

conceived at the end of my MMus Composition degree at Birmingham Conservatoire). My idea immediately piqued his curiosity and he invited me to his house that same evening.

During the dinner, I explained my idea to bind water and stones through music, using his Sounding Stones, inspired by the growth of stalactites and stalagmites, and he shared with me his own fascinating artistic vision. Our conversation continued while he and I were walking and visiting his Giardino Sonoro (<http://www.psmuseum.it>), an open-air museum where he exhibited megalithic circles, monoliths, Sounding Stones, stone seeds and many other sculptures. It was a unique and unforgettable experience that changed my life and my approach to sounds and music. After six years, I still feel the same intensity every time I return there.

During our first encounter, Sciola told me that he had been born to a farming family and grew up in a symbiotic relationship with the earth from which they earned their living, harvesting its fruits by hand. At an early age he had already shown great artistic talent and, thanks to a scholarship, had studied in a high school of art. After achieving a diploma, he was offered a well-paid teaching post at Cagliari's Artistic College. Nevertheless, on the day when he should have started his job, he was instead travelling the sea by boat. He had declined a role that would have confined him to Sardinia because he sought to learn from other artists around the world. He did travel and meet many artists around Europe and South America, even visiting Easter Island's stone giants, but claimed to have learnt more from the earth than from anything or anyone else. He considered that he had attended the 'University of Nature': he interiorised its laws, and from nature he drew the rules of his art.

1.3 Origins, time and nature

During the Bronze Age (c. 1,800 BC), a unique culture flourished in Sardinia. The ruins of the Nuragic Civilisation (Lo Schiavo, 2013), whose name comes from the Nuraghe, megalithic

circular edifices made by stones, still characterise the Sardinian landscape. This powerful prehistoric presence is the humus on which many Sardinian artists based and developed their artistic thoughts. Sciola considered stones both a sign of the past and of the present: 'an immeasurably important element of modern life' (personal communication). He often underlined that several modern inventions, such as quartz watches, or silicon microchips, are mineral-based on minerals, and frequently claimed that stones were 'before man' and would still be there 'after man'. Stones are an element of continuity which have marked Sciola's work and aesthetics, and which have profoundly influenced my vision of natural phenomena. Natural events, such as geological ones, simply may not be measured in the span of a human life. Often we perceive certain phenomena as though they were static, just because we do not have enough time to understand their evolution, their natural development.

1.4 Stones and sound

On the one hand, in the collective imagination, a stone is deaf and dumb. Greek mythology gives us several examples: whoever unfortunately crossed the gaze of Medusa was turned into stone; Zeus often punished humans by petrifying them. Incurring the wrath of the gods implied the impossibility for one to emit a sound (vibrate) and, therefore, to communicate with others. On the other hand, the relationship between stone and sound has ancient origins and is based upon percussion. One of the earliest known musical instruments is the lithophone (from Greek *λίθος*, stone and *φωνος*, voice, sound). According to *Oxford Music Online (Grove Music)*, a lithophone is

a sounding stone or series of resonant stone slabs or plaques. Lithophones occur in several forms: oblong bars suspended horizontally; vertically suspended plaques; or

(as has been recently introduced) circular stone discs arranged chromatically. They may also occur in the form of rocks, boulders, stalagmites, stalactites etc., which are sonorous when struck and show evidence of having been used as idiophones; such lithophones may more appropriately be termed 'rock gongs'.

Recent studies concerning the developing of art in caves, particularly in the Chauvet cave in France (Reznikoff, 2010), corroborate the fascinating theory that during the Palaeolithic Age, around 20,000 years ago, at the time of the first human settlements in the caves, a relationship between sound and stones had already been discovered.

When I first heard Sciola's fascinating ideas about the relationship between sound and stones, it evoked the theory of the Music of the Spheres by the Greek philosopher Pythagoras:

A concept attributed to Pythagoras, harmony having cosmic significance for the Pythagoreans. It seemed to them, as to others, that the heavenly bodies must, like other large bodies moving at speed, produce a sound as they whirl through space; since the bodies move at different speeds they must produce different notes, but together these are harmonious' (Howatson, 2013, p. 275).

This was a concept further developed by the German mathematician and astronomer Johannes Kepler (1571–1630) in *Harmonices Mundi* (1619). Sciola liked to think that, during their journey through the Universe, stones had absorbed its sound. Stones were considered a treasure chest, a shell wherein the primal sound was enclosed. Stemming from this idea, and inspired by Leonardo da Vinci's drawings, he began to carve stones with a precise geometry. After various experiments, in 1997, Sciola released the first Sounding Stone. He

did not claim to be a lutenist nor a musician, nor ever claimed to have invented anything, but maintained simply that he had been setting free the sound locked inside the stones.

In keeping with his religious – animistic – respect for nature and its rules, Sciola approached stones in a non-percussive way. He used to say that it was necessary to distinguish the sound of the percussion itself from the inner sound of the stones. Therefore he naturally used his hands in a way that was respectful of Nature, just caressing the top surface of his sculptures. The friction of warm hands triggered the steles' sympathetic resonance and allowed him to discover an unheard-of sound. This was a revolutionary innovation, giving rise to a stone-instrument that overcame musical possibilities confined to a purely percussive approach.

1.5 The Sounding Stones

The Sounding Stones are carved from white-ivory limestone or basalt rock, characterised by cuts made with a thick diamond blade, of variable size, depth and form. (Exceptionally, rose-coloured limestone is used, which generally emits a lower frequency than the white-ivory.)

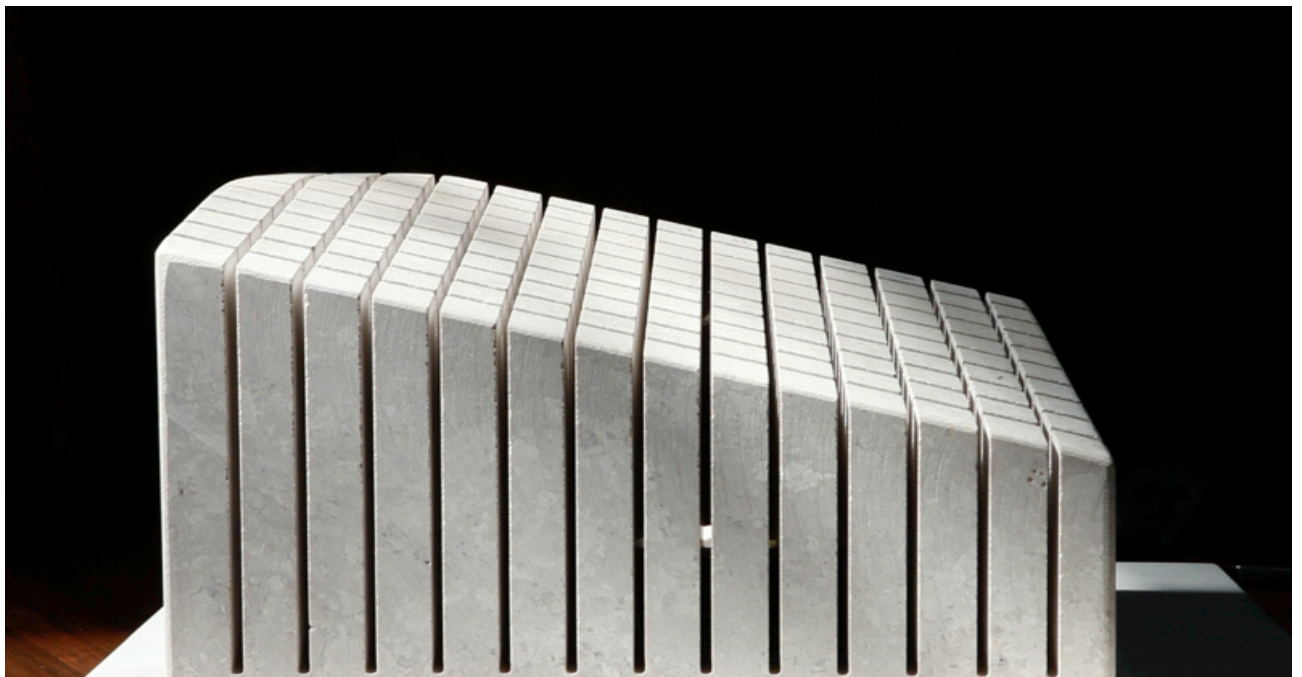


Figure I: Limestone Sounding Stone – 'keyboard' (photo: Andrea Granitzio).

Some Sounding Stones, so-called 'Keyboards' (Fig. I), have a rectangular base from which, through millimetrically precise cuts, were created a series of 'steles': small columns whose height is modulated in ascending/descending manner. This type of work of art offers the viewer different perspectives of the sculpture. From above, it has the image and texture of a perfectly square and homogeneous chessboard. From the right and left sides, the steles allow one to see (glimpses of) the space that runs through. From the front an oblique plane emerges, determined by the increasing height of the steles. The number of steles varies according to the keyboard's size, forming a cross-linked checkerboard whose precision of execution is the main characterising work element of the work.

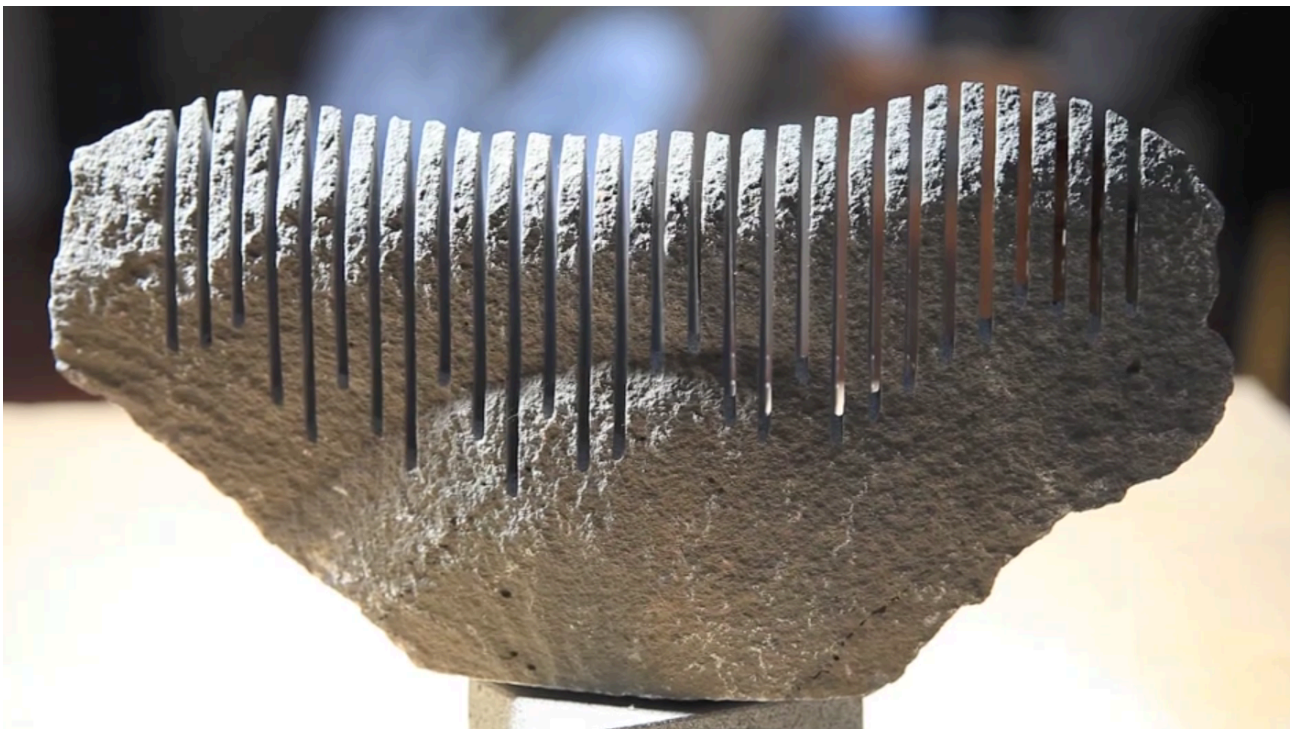


Figure II: One-row basalt harp (photo: Granitzio).

A similar carving characterises other Sounding Stones, made both of limestone or basalt, called 'Harps', constituted of one (Fig. II) or two rows of steles.

1.6 The Sounding Stones in my compositional practice

On the occasion of my very first contact ('impact') with the Sounding Stones, a genuine surprise, caused by the mere fact that such sound was generated by a stone, prevailed over any musical implication. The Stones represented a matter of fact, and initially I related to them as a source of sound without any compositional aspiration.

My compositional interest emerged when I myself had the chance to practise on the Stones and realised that I could 'control' their sound, just by changing the pressure of my hands on the top surface of the Stone. In fact, the peculiarity, or particularity, of the limestone Sounding Stones emerges when steles are rubbed downward with the palm of the hands, the friction of which activates the vibration of multiple steles at once. The steles' proximity allows the creation of a unique sound, caused by the sum of the frequencies produced individually, and by the creation and superimposition of the resulting harmonic sounds, which is, therefore, inextricably linked to the originality of this sculptural object and project. The Stones' harmonic resonance can be 'modulated' by varying the speed of the hands, the greater (faster) the friction, the higher the pitch of the harmonic resonance, and vice versa.

Years of experience had led Sciola as the sculptor to realise that it was not possible to identify a clear relationship between the size of the Stones, or of a single stele, and their sound frequencies. Any attempt that aimed to obtain two identical pitches from two like-sized steles was frustrated due to the Stone's texture. Sciola recognised that each single stele had its own pitch 'identity', and this natural quality turned each Sounding Stone into a unique work of art. But even though it was not possible to 'tune' a Sounding Stone prior to its carving, it is nonetheless easy to measure every single stele's frequency, with the aim of enhancing their individual musical melodic potential and also improving their chance to interact with other instruments.

In this way, then, any Sounding Stone effectively encompasses a small orchestra. It is, for example, sufficient to bow the edge of the steles to emit a rich harmonic sound, very similar to that of string instruments, with which it is, therefore, possible to interact in an articulated manner. If the bow is used on more than one stele at once, or two or more bows are used, or if the palm of the hand is rubbed on a Stone's top surface, the resulting effect is similar to the sound made by a string ensemble. Therefore, a Sounding Stone, with its own physical limitations, can play the dual role of soloist and/or of an ensemble, offering new perspectives and possibilities to those who want to explore its timbral potential. Such deepening of both the harmonic and melodic facets of the Stones initially prevailed over the rhythmic aspect, influenced by the non-percussive approach Sciola professed, until I discovered and developed the 'release pressure' technique, explained in Chapter 4.13, which allowed me, finally, to have a broad approach to the Sounding Stones and their musical potential.

From an organological perspective, according to the Hornbostel-Sachs classification, musical instruments are divided into four main categories, depending upon how an instrument vibrates to produce sound. Idiophones produce sound by vibrating themselves; membranophones produce sound via a vibrating membrane; chordophones produce sound by vibrating strings; and aerophones produce sound by vibrating columns of air. Therefore, for its material and acoustic characteristics, a Sounding Stone, especially one made of limestone, can be defined as a category-crossing 'instrument', dependent upon the manner in which it is used. The attached USB drive (Appendix 1) shows the techniques developed so far, divided as per four categories: Fingers; Hands; Bow; and Percussion.

Chapter 2 – Integration between modal jazz, contemporary music and improvisation

2.1 George Russell and the *Lydian Chromatic Concept of Tonal Organization*

I first approached Russell's *Lydian Chromatic Concept of Tonal Organization* during my Master's in composition. As a jazz pianist I had wanted to improve my improvisational skills and the Lydian Concept aroused my curiosity since it offered a new harmonic view and practical examples based upon a modal approach. At the heart of Russell's theory is the concept of 'Tonal Gravity', based on the principle that every tone within Western music's equal-tempered tuning relates to every other tone, either by being close to – or distant from – the 'centre of gravity', defined as being the tonic of the Lydian Scale. 'According to Russell, the Lydian scale is a seven-tone scale created by consecutive ascending fifths (i.e. C, G, D, A, E, B, F#) arranged within one single octave' (Burt, 2002, p. 77). This sequence establishes the most vertically unified 'harmonic order', whereby gravity brings back down each fifth to the singular 'Lydian tonic', as shown in Fig. III (overleaf):

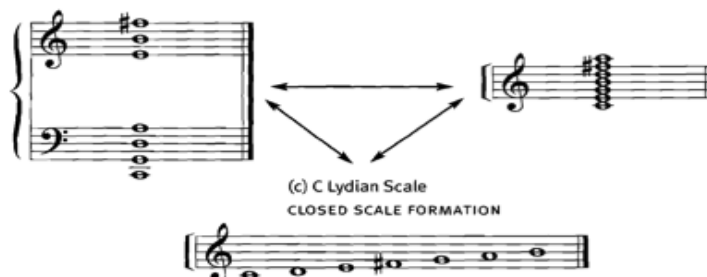
Example 1:2 shows the Primary Order of the Lydian Scale—a ladder of six intervals of a fifth—compacted into tertian and stepwise arrangements.

The C Lydian Scale

EXAMPLE 1:2

(a) ascending ladder of fifths
PRIMARY ORDER

(b) C Lydian (I) major chord
TERTIAN ORDER



All three arrangements of the C Lydian Scale sound in the state of unity with the C major chord and its C Lydian Tonic.

The Overtone Series

(Equal Temperament Approximation)

The overtone series in Example 1:3 introduces the interval of a fifth immediately following the initial octave. The fifth is thus established as the strongest harmonic interval. Lying at the base of the overtone series, the fifth is its foundation or cornerstone interval.

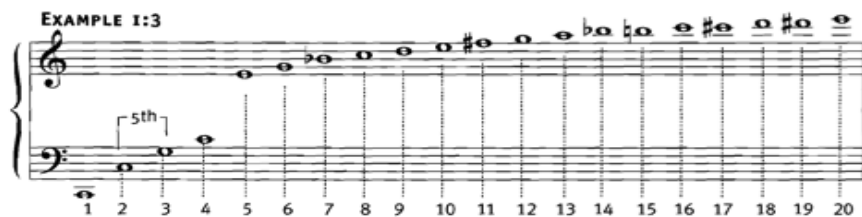


Figure III: Russell’s example of the Primary Order of the Lydian Scale (Russell, 1953, p. 2).

Having thus established this scale as his basis, Russell generates other parent forms: ‘by combining the six scales the improvisation may include all twelve pitch classes’ (Burt, 2002, p. 77). He subdivides his ‘Outgoing’ category of improvisation into two types: ‘ingoing’ and ‘outgoing’ vertical melodies, and further subdivides the category into three types: modal melodies, pan-modal melodies and chromatic melodies (Burt, 2002, p. 77).

Besides having found this theory interesting from a jazz improviser’s point of view, what inspired me the most, as a composer, were both the ideas of Tonal Gravity and of

Outgoing melodies. Their vertical connotation evoked the dripping of water that forms stalactites, and this led me to think about a composition whose structural development – its organic growth – could have been permeated by the notes of a harmonic series.

2.2. Toru Takemitsu and the Lydian Concept

Russell's *Lydian Concept of Tonal Organization*, first published in 1953, has generally been confined to a jazz context probably because it was perceived and used primarily as a practical handbook for improvisers. Critics and musicologists started to pay attention to the Concept just after it was mentioned as a source of inspiration and an influence upon the well-known contemporary composer Toru Takemitsu (1930–96), who gave an indication as to how this influence might actually be reflected in particular upon *The Dorian Horizon* (1966) for seventeen strings instruments, 'the work of Takemitsu in which his debt to Russell is most explicitly acknowledged' (Burt, 2002, p. 74).

Takemitsu was 'overwhelmed by the excellence of Russell's ideas' (Burt, 2002, p. 74). But the most interesting point that comes out of the literature comparing the use of modes in the music of Russell and Takemitsu, is that the Japanese composer takes more comfort and confirmation from Russell's intuition rather than simple inspiration. The use of modes becomes a way to escape from the equal-tempered scale that Takemitsu defines as 'omnipotent in modern Western music, but [adding that] in my case I rather value the concept of mode' (Takemitsu, 1987, p. 31). Takemitsu's language is based on a scale system that contains the hexatonic scales (analogous to Russell's Auxiliary Augmented scale and to Debussy's whole-tone scale), heptatonic (analogous to Russell's Lydian augmented), octatonic (identical to Russell's Auxiliary diminished) and nine-tone scales (as used by Russell).

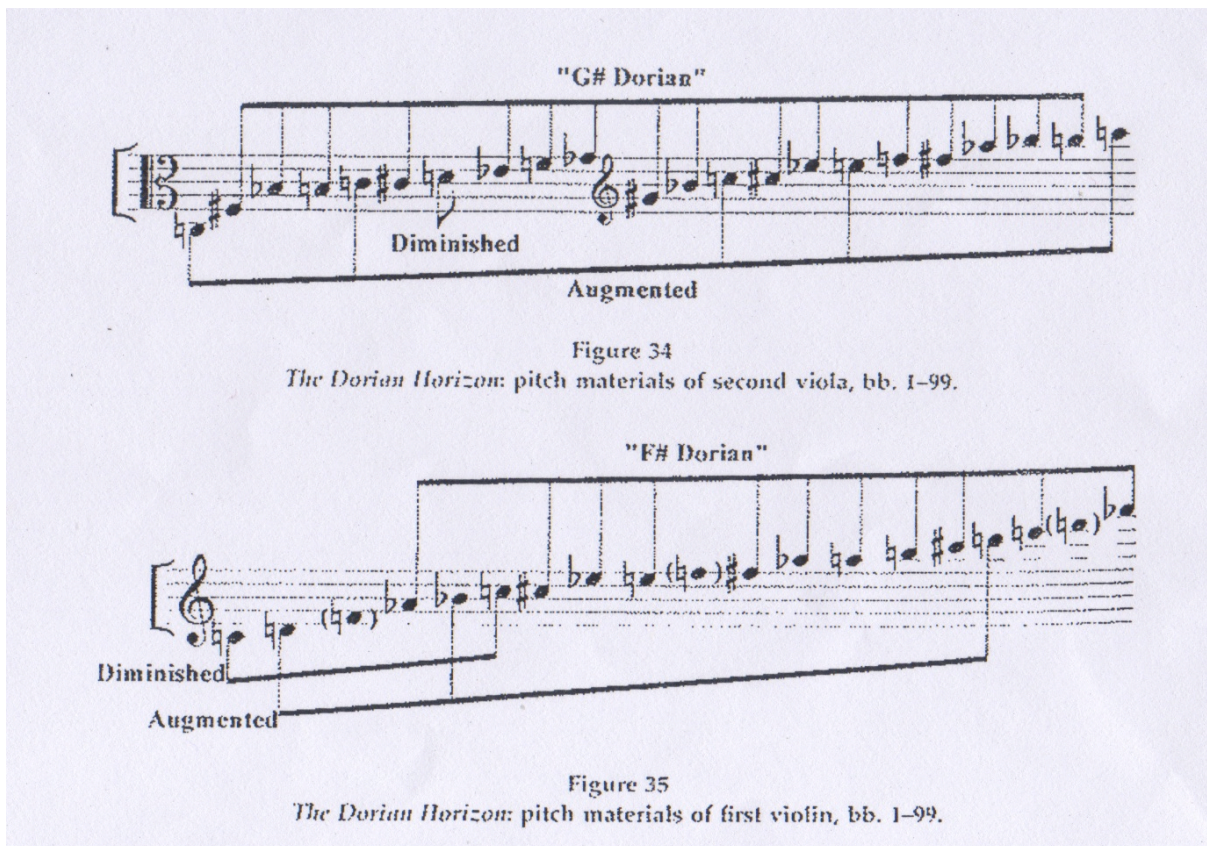


Figure IV: Example of *The Dorian Horizon* pitch material of second viola and first violin (Burt, 2002, p. 102).

What emerged and interested me the most in analysing Takemitsu's composition is his Russell-like modal approach. As the title suggests, musical material is developed horizontally, giving each melodic line a gamut of pitches belonging to different 'versions' of the Dorian mode, i.e. augmented, diminished (as shown above in Fig. IV), or auxiliary augmented. In a vertical plan the superimposition of several 'independent' modal lines often creates harmonic clusters that the Japanese composer calls 'shadow/light' effects. Each line is played with a specific technique, with the aim also of characterising different gamuts of sound. Takemitsu's modal approach led me to think about a harmonic structure based on a constant development of the same mode, evolving on the horizontal plane, according to Russell's modal scales system. These principles informed the first and the third movements of *Speleothemes*.

2.3. Degree of improvisation

The third area of research was related to improvisation, whose role is fundamental to the development of the second movement of my main composition. Two aspects of improvisation were involved in the compositional process: the first concerning the way musicians should interpret their own role within the orchestra, and the second concerning the timbre of the Sounding Stones. For the purpose of my research, 'improvisation' is not intended with its jazz connotation, but rather as a performance according to the inventive whim of the moment, as defined in *The Concise Oxford Dictionary of Music* (2013). Indeterminacy, in a given frame provided by the score, thereby forms one of the compositional elements.

On the assumption that it is not possible to find two identical speleothems, due to the huge number of variable parameters involved in the growth processes, the second movement aims to use improvisation as a tool to characterise uniquely every performance. According to the score, players are provided with several instructions that seek to coordinate their own personal contributions to the growth of the stalagmite. Although the melodic material of every instrument is built upon the same sequence of notes, free variations of length, dynamics and phrasing achieve the aim of improvisation, as will be discussed further in Chapter 5. Moreover, due to the material that the Sounding Stones are made of, it is not possible to repeat exactly the same two sounds in a row when the Stones are played by 'frictioning' the palm of the hands upon the upper surfaces. This natural uniqueness guarantees that there will never be two identical *Speleothemes*. For the purpose of this compositional research, improvisation will play out the role of liquidity, in contrast with the solidity of the written score, in order to represent both the concept of the unpredictability of the drip of water and to describe the liquid component in the growth process of the stalactites/stalagmites.

Equally, for the purpose of this research, Russell's principle of Tonal Gravity, combined with Takemitsu's idea of a horizontal harmonic development of modal melodic independent lines, have been used as a basis for conceptualising the vertical stalagmites' growth. Russell's Outgoing melodic concept, together with a measure of improvisation, gave me the cue for representing the uniqueness of each speleothem.

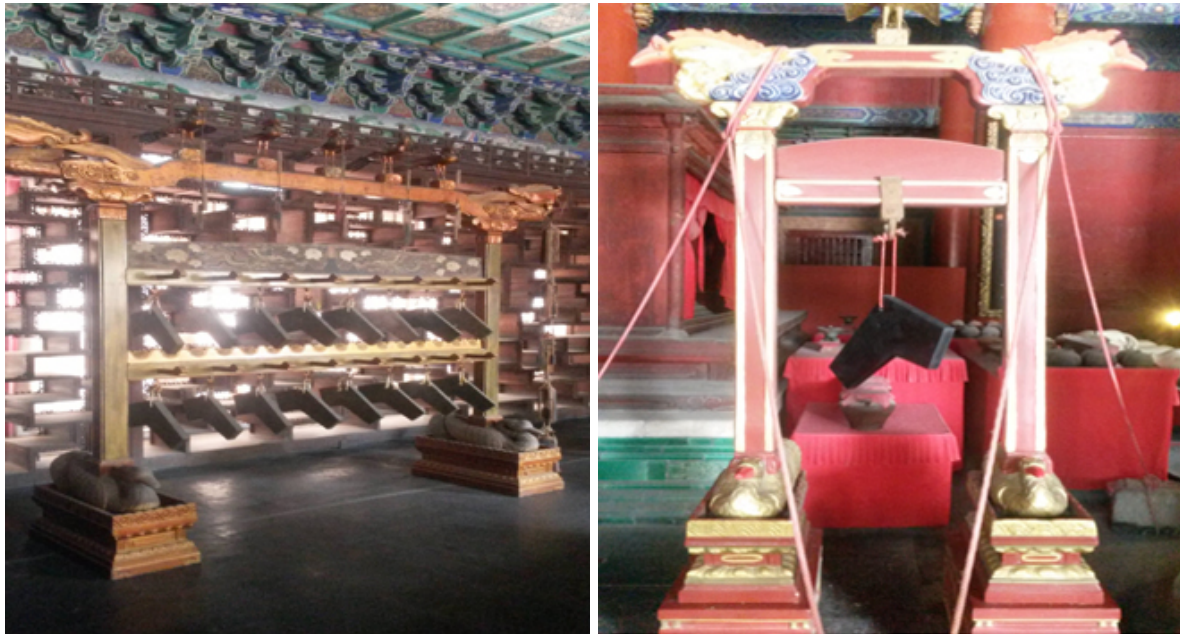
Chapter 3 – Interdisciplinary approach: Chinese musicology, Geosciences and Neurosciences

This chapter aims to offer an overview of the interdisciplinary experiences I have had during my research, showing how they influenced my approach to aesthetics and, finally, how they converged within the composition process.

3.1 Chinese musicology

From 1 May to 27 July 2015, supported by the Royal Birmingham Conservatoire, I undertook a visiting research project in China, collaborating with the Sichuan Conservatory of Music in Chengdu, as well as with other institutions. It was an extremely interesting experience that helped shape my research, and a unique chance to approach Chinese ethnomusicology in relationship with the stones. During the visiting research period I met several teachers and composers from Chengdu, Beijing and Shanghai conservatoires and discussed the philosophical and aesthetic roots of Chinese traditional music.

Amongst others I met ethnomusicologist Dr Yang Xiao at the Chinese Hong Kong University, with whom I had the opportunity to deepen my knowledge of the historical origin and the social role of the Qing instrument, an L-shaped lithophone constructed of resonant limestone, each tuned to a specific pitch.



Figures V and VI: Qing, Forbidden City, Beijing.

Historically, stones were thought to be symbols of longevity and stability, which helps to explain their role in ancestral rituals. The sound of the stone was considered the noblest musical expression coming from nature itself. For this reason during the Dynasties the Qing, literally the stone that sounds like a bell, was reserved for the Emperor or for his closest collaborators as a prerogative of the noblest spheres. This fascinating Chinese traditional consideration of sounding stones, coupled with their hierarchical function in Imperial society, strengthened my idea of a sound driven by stones from which the sound of the orchestra could stem.

Thanks to my Chinese mentor, Professor Zou Xiang Ping (teacher of composition and orchestration at the Sichuan Conservatory of Music), I also met Qin Wen Chen, who is currently considered to be one of the greatest Chinese living composers. I had the privilege of spending a whole day with him, talking about the aesthetics of music and sharing our thoughts concerning sound spatialisation and interaction between music and the audience. I was also able to attend a performance of one of his orchestral pieces, an interesting synthesis between Eastern aesthetics and Western contemporary music.

According to Qin Wen Chen, music is the sound of nature surrounding us. If Nature is our greatest teacher, then the role of the composer is to function as some kind of its *exegete*. Qin Wen Chen's music reflected perfectly the way he relates to it, in fact, his orchestral piece included quartets on both sides of the theatre balcony, in order to surround the audience. Moreover his music is inspired by the Chinese language, which includes four different pitches, whose variations change the meaning of the words. The pronunciation of vowels, for example, is often characterised by a fast or slow upwards or downwards glissando.

This inflection influenced the way that Qin Wen Chen writes for strings and woodwind, using advanced techniques, microtonal variations, often deliberately playing different – coexisting – shades of the same note, mirroring a sort of natural imprecision. This approach evoked Takemitsu's orchestration in *The Dorian Horizon*, where often the same material is played by the strings section with *strumenti divisi*, each one employing a different technique, to create a specific gamut of sounds.

Qin Wen Chen's music philosophy strengthened my approach to the sound of the Stones and helped me to reconsider its relationship with the strings section, which can be used to interact with and/or underline the naturally 'imprecise' pitches of the Stones. His nature-permeated conception of sound and space encouraged my own ideas concerning the last movement of *Speleothemes*, as will be discussed in Chapter 5.

My mentor Zou Xiang Ping introduced me to several music teachers, from whom I learned techniques and contemporary notation of traditional instruments, as well as to the Sichuan Opera and Chinese Traditional Orchestra. He also offered me the chance to give some lectures concerning improvisation at the Piano Department Academy. That experience enabled me to compare different perspectives related to traditional Chinese music modal approach and jazz, finding several points in common concerning the pentatonic system and

improvisation. Analysing Zou Xiang Ping's orchestral compositions helped me to deepen my understanding of Chinese formal conception, which in music, as well as in sculpture, painting and dance, is based on an observation of nature. Subsequently the structure, as well as the sound, is often the result of the reproduction, elaboration and imitation of animal shapes or natural elements.

This three-month Chinese research project was crucial in defining several aspects of my research. The musicological relationship between sound and stones in Chinese traditional culture, Qin Wen Chen's nature-related philosophy and Zou Xiang Ping's approach to modes and musical form, not only increased my knowledge of Chinese cultural background, but also influenced and informed my aesthetics and compositional approach, converging in the conceptualisation and writing of *Speleothemes*.

3.2 Geosciences and Speleology

In December 2015 an Italian delegation of physicists and geologists, including Professor Arrigo Cigna, President of the International Union of Speleology (UIS), and the President of the International Union of Radioecology (UIR), invited me to submit an abstract concerning my research on sound and stones to the 34th National & 2nd International Geosciences & Speleology Congress, held in Tehran, Iran (22–23 February 2016). I presented an abstract entitled '*Speleothemes: The Geotonal Earth Organization. Conversations about the birth of sound and music origin*', based on the connection between science and art and aimed at offering a composer's perspective of the geological phenomenon of the growth of stalagmites and stalactites.

On 31 January 2016, I received a formal invitation to attend the International Congress of the Geological Survey of Iran (GSI), which constituted a unique opportunity to share and spread my research in a scientific, non-musical context. In addition to deepening

my scientific background and developing my research, due to the concentration of world-wide experts on physics, geophysics and geographic matters, I also had the chance to get in contact with several universities interested in my approach to such a geological and speleological phenomenon. My research aroused the interest of Savoie University in France, and I was invited to share it at Creps de Vallon Pont-d'Arc in May 2016. Research at Savoie University is focusing particularly on the Chauvet caves, where the greatest examples of Neanderthal paintings are to be found. Unfortunately these caves are not open to the public, but I visited other caves and accessed publications on the role of the caves' sound in settlements where humans once lived and expressed their artistic skills, and where other forms of art flourished.

Finally in August 2016, at the 5th European Speleological Congress in North Yorkshire (UK), I visited Ingleton White Scar Caves with two Italian geophysicists, Dr. Giovanni Badino and Dr. Daniela Pani. After the visit we talked about the formation of speleothems and about the observation scale of natural phenomena. It emerged that from a geophysicist's perspective there is no difference between a sea wave and a mountain, since both are natural elements in constant movement. What changes is the human point of view. Movement is clearly perceivable in waves, but not in mountains, only because there is insufficient time to observe it. We perceive geological phenomena as static, but mountains themselves are 'living' evidences of the constant Continental Drift, even if their movements are observed much less frequently than other natural phenomena. We agreed that the same principle could be transferable to speleothems. Even if it is possible to observe the dripping, it is not possible to contemplate the significant development of stalactites/stalagmites, since they take longer than a human lifespan to grow. What humans can perceive is a single frame of the geological phenomenon, in a crystallisation of time. The whole formation process is perceivable and understandable by analogy with other

completed speleothems.

That conversation was crucial to the development of my main composition, especially its first movement – ‘Stalactite’. Everything came full circle, since it linked back to the first time Sciola and I discussed the relativity of human perception of time compared to the stones’ ‘lifetime’. I realised that I had to reconsider the relationship between stasis and movement and to overcome this oxymoron in the timeframe of the composition, with the challenging aim to create a flux that could syncretically encompass both elements.

3.3 Neurosciences

On 27 April 2016, I conducted the premiere of my composition *Time Persistence* for string quartet and Sounding Stones, at the church of San Pietro in Vincoli, Rome, as part of the Stone Tales Festival, held by La Sapienza University. The premiere was performed as a key element of an event entitled ‘La voce della pietra – Il Mosè di Michelangelo e le Pietre Sonore di Sciola’ (The voice of the stone – Michelangelo’s Moses and Sciola’s Sounding Stones), and it featured Sciola himself playing the Sounding Stones and talking about his artworks.

At the end of the performance Dr Veronica Ghiglieri, an Italian neuroscientist based at the University of Perugia, Italy, who was attending the concert, proposed to conduct scientific experiments to study the effect of the Sounding Stones on cortical brain activity. Ghiglieri’s ideas stemmed from significant empirical evidence concerning the structural and functional plasticity of the human brain when involved in complex tasks associated with musical activities. The project’s rationale could be based upon multiple lines of evidence indicating that around the 20th to 30th week of prenatal life, a foetus first starts to hear sounds and to develop a musical language, consolidating several brain functions (Kornas-

Biela, 2014). The unique and unheard sound of the Sounding Stones could be used to re-open that sensitive period for the development of auditory perception, in order to offer new ways to add to the treatment of Parkinson's disease. Just prior to his own death, Sciola had accepted the idea of this project enthusiastically, since those scientific theories seemed to confirm his intuition concerning the relationship between the origins and perception of sound.

The project, in which I am personally involved, is currently running at the Laboratory of Neurophysiology, Santa Lucia Foundation, Rome, under the name of 'NeuroStones: re-opening critical periods in a therapeutic framework with the sound of the stones'.

Chapter 4 – Preparatory works

4.1 Compositions for Stones: aims and functions

I spent much time recording Sciola performing on his Stones: each time he carved a new Stone he invited me to bring along my recording equipment to record further sounds. Thus I have archived several hours of samples and sound fragments, which have become my own personal library.

In March 2014, Sciola was invited by the Ente Lirico di Cagliari on Sardinia to design and stage Puccini's *Turandot* scenography, and to plan an exhibition that was to be held in the foyer of the Teatro Lirico in Cagliari. We discussed the chance to compose some new music with the Sounding Stones that would accompany and surround the audience during the exhibition, the day of the premiere. This challenging idea led me to think about some compositions for Stones alone that could both show the Stones' timbral, melodic and harmonic properties and create a sonic environment to achieve the exhibition's purposes.

With the exception of *Erinni*, where I played the Stones myself, I composed all the pieces using pre-recorded and archived sound fragments of limestone and basalt, organising the sonic material according to the techniques used. My aim was to characterise each composition with a recognisable or prevalent timbre, so as to create the widest possible range of sound atmospheres.

In order to capture, in Sciola's words, the 'inner sound of the stones' (personal communication) during the recordings, I have placed two or three contact microphones (two AKG C 411 and one Schertler BASIK SET) at the bases of the Stones, from where the steles stem. Another two cardioid microphones (Behringer C-2 small-diaphragm) were used to capture the ambient sound. With the aim of preserving the purity of the Stone's sound I did not use any filters or plugins during either the recording or production processes (the

only exception being the initial ‘knock-knock’ sound of *Heaven’s Gate*, where Logic’s Space Designer reverb was used). Four works have been composed: *Heaven’s Gate*, *Erinni*, *Stonature* and *Heart of Stone*, published in June 2014 on a CD entitled *Heart of Stone – Cuore di Pietra*. These pieces will be analysed in relation to their distinctive qualities in terms of timbre, techniques used and the material of the stones.

All the pieces for Stones included in this section are the result of experimental, practical and empirical approaches to the Stones; they have not been notated as scores.

4.11 Collection of works

Heaven’s Gate, composition for basalt and limestone (6.38)

This work is articulated through five tracks: two tracks with basalt, intended to produce a background sound, and three with limestone. It explores the sonic potential of a rare curved limestone that is revealed when played with, or activated by, a bow. The majority of limestone sculptures are rectangular-shaped, because a curved shape implies that the marginal steles would be too small: hence fragile and easy to break. The curve-shaped Stone used here is like a string *ponticello* and it enables a playing of the steles with the bow, both individually or two at a time, like a string instrument’s double-stopping. The outcome is an often dissonant, very high-pitched harmonic-like sound, which is the prevalent element of this composition.

Techniques used:

- Rubbing the side of a basalt Stone slowly with a small stone block;
- Bowing the top of a curved limestone, playing alternatively on one or two steles at the same time;
- Rubbing slowly one side of the limestone harp with a small piece of wood;

- Rubbing with the palm of the hand on the top surface of the limestone Harp.

Erinni, composition for limestone (7.02)

The title of *Erinni* comes from three Greek infernal goddesses: three furies. In Greek mythology Erinyes denotes 'dark forces of the earth, representing the power of retribution and revenge, especially in the family' (Blackburn, 2016). The work was composed by employing the sounds of three large limestone harps, each one played with a different technique. I experimented with and recorded the sound of each of these Stones, playing them continuously in order to establish a clear characterisation of their own sound.

The techniques used have allowed both a percussive and melodic outcome, since sometimes a prolonged friction induced deep vibrations and suddenly certain harmonic sounds emerged. The piece is articulated by means of three tracks, the first and second ones consisting of a single sound per Stone; meanwhile, the third is a progressive superimposition of the first two plus the third, symbolising the three Erinni surrounding their victim.

Techniques used:

- Rubbing slowly one side of the Harp with a small piece of limestone;
- Rubbing slowly one side of the Harp with a small piece of wood;
- Rubbing with the palm of the hand on the top surface of the limestone Harp.

Stonature, composition for basalt and limestone (8.24)

The Italian word *stonature* means literally 'out of tune'; figuratively, it connotes something being in the wrong place. This title also plays with the combinations of the English words Stone + Nature. The work consists of some twenty-two tracks employing basalt sound and

one track of a rare rose limestone harp. It explores the potential of basalt when both the top and sides of the Stone are rubbed with a stone block: the passage of the stone on top of the steles gives a pitched drumming sound that, together with the iron-like background given by rubbing the Stones' side, is the prevalent element of the composition. By contrast, the rose limestone, rubbed on its top with the palm of the hand with medium pressure, generates a powerful harmonic resonance.

Techniques used:

- Rubbing the top surface of a basalt Stone swiftly with a small stone block;
- Bowing on the top of the stele of a limestone keyboard;
- Rubbing with the palm of the hand on a limestone keyboard.

Heart of Stone, composition for basalt and limestone (5.22)

This work explores the Stones' melodic potential and was composed with musical material taken from a limestone keyboard whose right row of external steles is 'tuned' in D harmonic minor. Sciola used to play it by means of a double-bass bow:



Figure VII: Transcription of *Heart of Stone*, main theme as played by Pinuccio Sciola.

I have de-constructed this theme, and have then isolated some of its fragments and repeated them on six tracks with the aim of creating a melodic/harmonic mobile texture. The piece starts with a sound achieved by rubbing a fragment of basalt upon the top surface of a basalt sculpture: it is conceived as a contact between two pumice stones, whose sparks originate the sound. The main theme is played over a background sound produced by

rubbing with the palm of the hand on the upper surface of a limestone keyboard. In total, the work comprises eleven tracks.

Techniques used:

- Rubbing the top surface of a basalt Stone swiftly with a small stone block;
- Bowing on the top of the stele of a limestone keyboard;
- Rubbing with the palm of the hand on a limestone keyboard.

Working with Sciola helped me to explore different techniques and led me to develop my own, with the aim of deepening the musical possibilities of the Stones. The working approach consisted in isolating single fragments, focusing upon the sounds' small details and shades, and improving my technique to obtain a precise response from the Stones. This developed my awareness of the Sounding Stones' potential. Those four compositions were the first step towards a more articulated way to compose for Stones, which culminated in *Pangaea*.

4.12 *Pangaea*, composition for basalt and limestone (12.08)

The notion of Pangaea denotes 'A single supercontinent which came into being in late Permian times and persisted for about 40 million years before it began to break up at the end of the Triassic Period; or, in the view of some people, which existed throughout most of the Earth's history prior to the Triassic. It was surrounded by the universal ocean of Panthalassa' (Allaby, 2008, p. 418). This work, for basalt and limestone, is divided into four movements: 'Magma', 'Tectonic plates', 'Glaciation' and 'Deglaciation', creating a suite inspired by one of the planet Earth's formational steps. All the techniques developed so far for playing the Stones are involved here (friction exerted upon different types of Stone, rubbing of hands and of stones' block, pizzicato, 'release strokes', bowing, etc).

I – ‘Magma’ (0.00–3.25)

The first movement is inspired by the slow lava flows that precede the solidification of the Earth’s continental crust. It is made from several basalts, whose sounds, due to their volcanic origin, gave the best outcome for the purpose of my idea. This basalt is

A dark-coloured, fine-grained, extrusive, igneous rock composed of plagioclase feldspar, pyroxene, and magnetite, with or without olivine, and containing not more than 53 wt. % SiO₂. [...] Basalt flows cover about 70% of the Earth’s surface and huge areas of the terrestrial planets, and are therefore arguably the most important of all crustal rocks. Alkali basalts are typically found on oceanic islands and on the continental crust in regions of crustal upwarping and rifting. (Allaby, 2008, p. 54.)

To represent the ‘Magma’ movement I have employed three techniques, consisting of:

- Fingers and nails ‘pizzicato’ on the top and sides of the steles;
- Rubbing the top of the stele slowly with a small stone block;
- Rubbing slowly, in a circular motion, both sides of a basalt Harp.

II – ‘Tectonic plates’ (3.25–5.38)

The second movement is dedicated to the notion of continental drift, occurring subsequent to the consolidation of magma. Here, the sound of basalt, rubbed in a circular fashion, is predominant. To this basis I added a limestone sound, played with a bow, as well as the sound of a limestone keyboard played with the palm of the hand. To convey the sense of movement and an inevitable colliding of tectonic plates, which originate mountain chains, I added a rhythmical cell made by rubbing with the palm of the hand upon the top of a large limestone Harp.

The five techniques utilised here, consist of:

- Fingers and nails 'pizzicato' on the top and sides of the steles;
- Rubbing both rapidly and slowly the top of the stele with a small fragment of basalt;
- Rubbing slowly, in a circular motion, both sides of the basalt sculptures;
- Bowing on top of the steles;
- Rubbing with the palm of the hand on a limestone Harp, alternating light and medium pressure

III – 'Glaciation' (5.38–c. 8.14)

The third movement evokes the periods when the surface of the Earth was covered by ice, with this climatic change represented by a radical change of timbre, thanks to the totally different texture of limestone: a 'sedimentary type of rock composed mainly of calcite and/or dolomite, which is often of organic, chemical or detrital origin' (Allaby, 2008, p.337).

An 'icy' sound is obtained by the superimposition of several tracks of limestone keyboard played with the palms of the hands. Different dynamics and speeds originate notes of varying length and pitch. To give a sense of continuity in the sequence of geological eras, the same melody originated by the limestone played with the bow has been maintained.

Techniques used:

- Rubbing with the palm of the hand, both rapidly and slowly, on the top surface of a limestone keyboard, alternating light and medium pressure;
- Bowing on the top of the stele.

IV – ‘Deglaciation’ (c. 8.14–12.08)

A pitched percussive sound obtained by beating a finger on the top surface of a limestone keyboard introduces the glacial retreat and provides a prelude to the formation of waterways systems. This last movement is characterised by watery sounds reminiscent of ice dissolution: water dripping and flowing, raining, and finally, crystal formation. All these sounds were created using limestone keyboards and harps, including experimentation with several techniques to obtain the water dripping and crystal formation effects.

I have called the first of these techniques a ‘release pressure upstroke’. It consists of exercising pressure with a finger on one stele and then rapidly lifting the finger and thus releasing the pressure. The detachment induces the vibration of the stele. It also creates a unique effect as a result of the sound of the detachment itself, plus the pitched sound caused by the stele’s vibration. Secondly, the crystal formation effect is achieved by brushing a jazz open brush stick across the top and sides of a limestone keyboard and/or harp. This passage of the metal brush across several steles, each one with a different pitch, creates a peculiar metallic and melodic sound.

Techniques used:

- Percussion on the top on a limestone keyboard with one or more fingers;
- Rubbing with the palm of the hand both rapidly and slowly on the top surface of a limestone keyboard, alternating light and medium pressure;
- ‘Release pressure stroke’, by pressing and lifting a finger on one or more steles;
- Brushing the top and sides of limestone keyboard and harp with a jazz open brush stick.

Pangaea constituted a fundamental step towards the composition of *Speleothemes* for three main reasons. Firstly, it made me aware of the timbral potential of the Sounding

Stones when used in an ensemble fashion. The superimposition of about seventy different tracks, each experimenting with and developing several techniques, allowed me to realise that the Stones could be considered as a kind of self-sufficient orchestra. Secondly, the Stones' range of timbral possibilities led me to think in structural terms and also made me aware that I could articulate a single composition of several movements, whereby each of them was characterised by a differentiated, recognisable and idiosyncratic timbre. Thirdly, the versatility of the Stones allows different type of sounds, gradually progressing from a percussive to a melodic sound. Crucially, this helped me realise that I could use the Stones' sound to represent the flux concept of an almost imperceptible, but inexorable and constant – metaphorically organic – transformation and development.

The result of this timbral exploration was a surprising texture of harmonic sound plus a rubbing 'noise' background, which inspired me and pointed the way forward to a new compositional approach, focused on the aforementioned aspects. These three elements concerning timbre, structure and the concept of an organic growth/development, converged and constituted the basis for the composition of *Speleothemes*, as will be explained in Chapter 5.

4.2 Compositions for Stones and small ensemble

This section aims to demonstrate my aesthetic approach in composing music for Stones and other instruments. It focuses on the analysis of several aspects of the compositional process, including conceptualisation, structure, techniques and notation issues, as found within two compositions:

- ***Time Persistence***, for string quartet and Sounding Stone;
- ***Octahedron***, for string quartet and woodwind quartet and Sounding Stone.

4.21 *Time Persistence*, for Sounding Stone and string quartet ('keyboard' limestone, violin, viola, cello and double bass) (5.10)

This composition was premiered at the Basilica di San Pietro in Vincoli, Rome, on 27 April 2016, alongside the aforementioned 'Stone Tales – La voce della pietra – Il Mosè di Michelangelo e le Pietre Sonore di Sciola', featuring Sciola playing the Sounding Stones. Before the performance, Sciola told the audience the story that when Michelangelo completed his statue of Moses he was so fascinated by its perfection that he asked the statue: 'Why don't you speak to me?' Frustrated by its silence, Michelangelo slammed down his hammer on Moses' knee. Sciola explained that Michelangelo carved the sculpture on a saccaroid marble: a kind of material that, due to its texture, is very soft and easy to carve, but that does not allow vibration, or thus sound. With the aim of reconciling Michelangelo with the 'inner voice' of the stone, Sciola played his Sounding Stones in front of Moses and then we performed *Time Persistence*.

Conceptualisation and structure

Time Persistence was inspired by one of the first topics Sciola and I discussed during our first encounter. As previously mentioned, Sciola considered stones as signs of the past, present and future: a presence symbolising an element of continuity during humankind's transience on Earth. Carving stones was an attempt to overcome the time-limits of human life and to pass on human artwork from generation to generation, until nature re-absorbed – phagocytised – it all.

The presence of stones on Earth preceded the appearance of humans and will arguably last longer. Analogously the composition opens and closes with the sound of the Stones. The structure follows the scheme ABACA, whereby A is dedicated to the sound of the Stones, and B and C are sections where strings play over the Stone's texture. Both the time

signatures (section B is in 4/4 and section C in 3/4) and keys (B minor to D major and back again) change to represent human evolution in different moments in time; however, the sound of the Stone always remains the same. This constant presence existing alongside the strings is emphasised by the indication 'Undismayed', placed next to the metronome marking of 60 bpm.

Techniques and notation

The piece explores the potential of the Sounding Stones played with the hand-friction technique. In order to achieve the aim of a clear notation I have used symbols for the right and left hands, together with a down-arrow to indicate the hands' downward movements and a brief description consisting of 'Rub the palm of the right and left hand alternatively, from up to down continuously', as indicated in Fig. VIII (overleaf). This was the first instance where I used this kind of description. Later on, I distinguished light pressure from medium pressure in order to achieve a different sound.

Time persistence was performed in a large church. Both the Sounding Stones and the string quartet were not amplified. While I was conducting the piece I realised that, even if sometimes the volume of the strings prevailed, this was not having a negative effect on the performance. On the contrary, the eventual and temporary preponderance of the strings, emphasises the second and even more the third 'A' sections, underlining symbolically the constant presence of the Stones and their role. However, the conductor is provided with an indication consisting of 'string players should always consider the Stones' dynamics and play under or at the same dynamic level', as shown in Fig. VIII.

Time Persistence

♩ = 60 Undismayed

The image shows a musical score for the piece 'Time Persistence'. It consists of five staves: Violin, Viola, Cello, Double Bass, and Sounding Stones. The top four staves are for string instruments, each with a treble or bass clef and a key signature of one sharp (F#). The Sounding Stones staff is at the bottom and features a 4/4 time signature and a key signature of one sharp. Above the Sounding Stones staff, there is a text instruction: 'Rub with the palm of the right and left hand alternatively, from up to down'. Below this instruction, the Sounding Stones staff shows four measures of music. Each measure begins with a hand icon (palm facing down) and a downward-pointing arrow, indicating a 'rubbing' action. The notes on the Sounding Stones staff are represented by vertical lines with small circles at the bottom, suggesting a specific pitch or frequency.

Figure VIII: Granitzio, *Time Persistence*, Sounding Stones notation and score instructions.

This composition is very significant to me. Not only it was the first piece that I wrote for Stones and strings, it was also my personal last tribute to my mentor. I was aware that our first performance with strings could also have been the last. Sadly fifteen days later, on 13 May 2016, Pinuccio Sciola passed away following a long illness.

Octahedron, for Sounding Stone, woodwind quartet (flute, oboe, clarinet and bassoon) and string quartet (violin I, violin II, viola and cello) (7.12)

This composition was written for the Birmingham Frontiers Festival, held in 2016. Here is the text from the concert's programme note:

The daily practice routine of a string and a woodwind quartet, respectively exploring some possible combinations of C and G Lydian augmented scale notes, is abruptly interrupted by the unexpected appearance of an uncommon instrument, which

destabilises the previously established balance. The sound of the Stone is like a magnetic field and the quartets' compass needle suddenly goes mad. A new 'North' prevails and both quartets are slowly and irreversibly attracted by the Stones' ancestral recall.

Conceptualisation and structure

In this composition the sound of the Stones plays a symbolic role, inspired by a Pythagorean view of the origin of sound. As described in the programme notes, the sound of the Stone is conceived like a primal gravitational pull, around which other instruments gradually gravitate. The piece is conceived as a progressive intertwining of eight lead voices, divided into two groups of four each. Instruments of the first group, including flute, oboe, clarinet and bassoon, each play four groups of three notes, extracted from a G Lydian Augmented scale, as shown in Fig. IX:

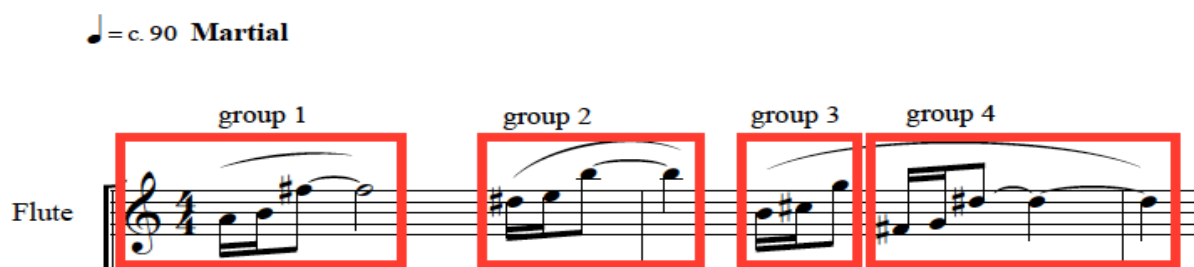


Figure IX: Granitzio, *Octahedron*, G Lydian Augmented groups, flute first exposition.

Instruments of the second group, including violin I, violin II, viola and cello, each play four groups of three notes, extracted from a C Lydian Augmented scale, as shown in Fig. X:

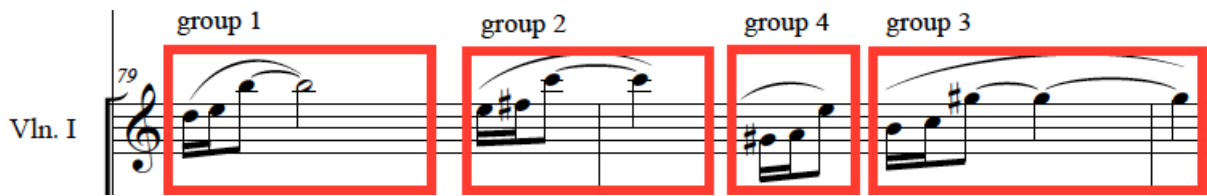


Figure X: Granitzio, *Octahedron*, C Lydian Augmented groups, violin I first exposition.

Each instrument plays different sequences of groups, according to the following scheme

(Fig. XI):

G Augmented Lydian scale	Flute	1234			
	Oboe		4231		
	Clarinet			3214	
	Bassoon				2341
C Augmented Lydian scale	Violin I	1243			
	Violin II		4321		
	Viola			3142	
	Cello				2413

Figure XI: Granitzio, *Octahedron*, sequences of groups' scheme.

In order to emphasise the autonomy of each voice even when the instruments of each quartet are using continuously the same melodic material, sequences are always rhythmically different. This represent a lack of dialogue and understanding among individual voices, each one absorbed by its mechanical and 'Martial' routine, as indicated next to the metronome marking of 90 bpm.

The piece is divided into eight sections, according to the scheme in Fig. XII (overleaf). The Stone's sound intervenes on four occasions, progressively destabilising the balance of the other instruments. The first time, bars 45–48, it interrupts the woodwind sound, causing a clumsy and clanging stop. The second time, bars 67–78, it causes the halting of the woodwind, which are substituted for by the strings. On the penultimate occasion, bars 100–

110, it destabilises the balance of both woodwind and string quartet, leading to a short final dialogue between flute, cello and Stone, bars 111–134 (see Fig. XIII).

Section	Bars	Woodwind	Strings	Stone
A	1–21	Fl		
B	22–42	Fl, ob		
C	43–71	Fl, ob, cl, bn		45–48
D	71–100			67–78
E	101–110	Fl, ob, cl, bn 107–110	Vn I, vn II, va, vc	100–110
F	102–134	Flute – cello – Stone trio		
G	135–173	Fl, ob, cl, bn	Vn I, vn II, va, vc	169–184
H	174–184	Fl, ob, cl, bn	Vn I, vn II, va, vc	

Figure XII: Granitzio, *Octahedron*, scheme.

14 *meno mosso e leggero, cercando il dialogo*

Fl. *espress.*
mp

St *arco*
mp

Vc. *mp*

Figure XIII: Granitzio, *Octahedron*, flute, cello and Stone trio ‘cercando il dialogo’ – seeking dialogue.

After the trio section, both quartets attempt to resume their own routines, but the sound of the Stone has already influenced irreparably the balance of each instrument. Gradually, both woodwind and strings lose their compass until they gravitate around the magnetic attraction of the Stone’s primal sound.

Techniques and notation

Octahedron explores the sound of the Stones when played with a bow. It is not so much based on pitches (even though their role is relatively important for the final result), but rather on the mere fact that it is possible to produce a sound bowing a stone. Given that every Stone is a unique instrument with its own pitch series, the piece can only be performed with precise pitches on a predetermined Stone. In order to allow performances with any limestone keyboard or Stone Harp, and create the effect of pitch variation from the initial one, the first note should be played in the central stele of a row of choice, to be considered as a central reference-point. A one-line staff proves useful to represent graphically a dividing line that separates the notes over the line, which should be played on the right of the central stele, from those notes under the line, which should be played on the left of the central stele (as shown in Fig. XIV):

The image shows a musical score for three instruments: Flute (Fl.), Stone (St.), and Cello (Vc.). The score is divided into three measures. The Flute part is written on a single-line staff with a treble clef and a key signature of one sharp (F#). The Stone part is written on a single-line staff with a C-clef (soprano clef). The Cello part is written on a standard five-line staff with a bass clef. The key signature for the Cello part is one sharp (F#). The score includes dynamic markings: *pp* (pianissimo) for the Cello in the first measure, *p* (piano) for the Flute in the second measure, and *mp* (mezzo-piano) for the Flute in the third measure. The notes are arranged to show pitches above and below a central reference point, indicated by a horizontal line in the Stone part.

Figure XIV: Granitzio, *Octahedron*, flute, cello and Stone trio, notes over and under the central pitch.

In order to optimise the effect of a centripetal magnetic attraction, both quartets should be placed around the Stone according to the following scheme (Fig. XV overleaf):

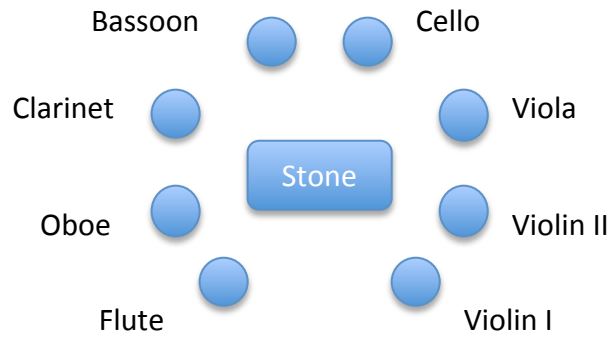


Figure XV: Granitzio, *Octahedron*, instruments on stage.

With the purpose of representing the quartets' disorientation, I introduced some elements of improvisation concerning pitches, phrasing and dynamics, within a given rhythm (as shown in Fig. XVI). The alternation between moments when instruments are capable of keeping control of their routine and those moments when they lose control allows different degrees of variety: hence a different performance every time.

Figure XVI: Granitzio, *Octahedron*, improvisation notation.

Octahedron proved a key step towards the composition of *Speleothemes*. The vertical contrast between melodic lines, generated by C and G Lydian scales, has been developed especially in the third movement of *Speleothemes*, where I focus on the pan-modal harmonic outcome created by the 'Joint' between 'Stalactite' and 'Stalagmite'. Using degrees of improvisation, allowing players to bring their own personal and individual contribution to the performance and having different performances every time, is the main idea upon which the second movement is based. Finally, *Octahedron* was the first experiment with sound spatialisation, further developed in both the second and the last movements of the orchestral piece.

Chapter 5 – Composition for Stones and orchestra: *Speleothemes*

5.1 Etymology of speleothem and *Speleothemes*

Speleothem ('flowstone' or 'dripstone') is 'calcium carbonate rock deposited in caves by the precipitation of calcite from water as excess dissolved carbon dioxide is diffused into the atmosphere. [...] It] takes various forms, including stalactites, helictites [...] and stalagmites' (Allaby, 2008, p. 179). The word's etymology relates to the ancient Greek: σπήλαιον (spēlaion), cave + θέμα (thema), deposit. By extension, the very word *Speleothemes* is a merging of the root 'speleo' and the word 'theme', with its musical implications. It represents a theme stemming metaphorically from stalactite and stalagmite growth inside a cave.

Speleothemes consists of four movements. The first three represent, respectively, the formation of a 'Stalactite', a 'Stalagmite' and the 'Joint' between them. The fourth one, entitled 'Before', aims to emulate the chamber where speleothems grows. The four movements are conceived and structured into sections that can be played separately but, when played together, create a suite, a macro-piece, emulating speleothems' growth.

The difference between a stalaCtite and stalaGmite, is often explained by saying that, C is for ceiling and G is for ground, as shown in Fig. XVII overleaf. Stemming from Russell and Takemitsu's modal approach, I reinterpreted aesthetically and figuratively the concept of Tonal Gravity, which, for the purpose of my research, is conceived metaphorically as the drip of water from the stalactite downwards to the stalagmite, from Ceiling to Ground, *ossia* from C to G considered as notes and modal roots or centres.

The whole composition is informed by the idea of material in constant organic development: a metamorphosis that involves its constitutive components in a continual transformational process, such as occurs in natural phenomena. From this perspective, C

and G are conceived as naturally opposed elements converging slowly to create a third entity, which draws its substance from their union ('Joint'). This chapter offers a detailed analysis of the compositional process, and the aesthetics and technical issues encountered.



Figure XVII: Educational signs in the Luray Caverns in Virginia to promote public understanding of the difference between stalactites and stalagmites.

5.2 'Stalactite'

The opening movement is informed by two principles developed by Russell in his *Lydian Chromatic Concept of Tonal Organization*: 'Tonal Gravity' and 'Outgoing Melody', and is driven by the intent to combine the concepts of stasis and movement. The work has been conceived as a flux in constant evolution, but for the purpose of a better understanding of both the conceptualisation and the compositional process it will be subdivided into six phases and analysed accordingly. These six phases are:

- Detachment
- Path
- Impact
- Formation

- Dripping
- Helictites

Phase 1: Detachment

The composition opens with the sound of a Sounding Stone, played on a C-tuned stele with a bow. It represents the moment when the first drop of water detaches from the ceiling and passes through the air downwards to the floor of the cave.

Phase 2: Path

The movement of air caused by the C drop dripping is represented by a clarinet air flux towards the strings of an open piano whose sustaining pedal is raised, to allow the sympathetic resonance of all notes touched by the air. The result is a pan-modal chord, which symbolises all the notes binding the ceiling with the ground.

Phase 3: Impact

The impact of the drop upon the ground is a G pitch, which interrupts the silence of the cave and causes the dispersion of both the energy accumulated by the drop of water during its path towards the floor and the material eroded from the ceiling. The contact with the surface of the cave induces centrifugal and concentric movements of water, represented by three progressive phases linked dynamically, harmonically and rhythmically. Dynamic dispersion is symbolised by a progressive decrease from *ffp* to *fp* to *mfp*, diminishing into a *pianissimo*; harmonic dispersion takes its cue from Russell's 'outgoing' melody principle.

According to Russell's Concept it is possible to obtain seven modal scales by adding a series of progressive alterations 'outgoing' from the modal Lydian Tonic, as shown below in Fig. XVIII (overleaf):

Lydian scales	Lydian scales progressive alterations						
Lydian	IV#						
Lydian Augmented		IV# + V#					
Lydian Diminished			IIIb + IV#				
Lydian Flat 7				IV# + VIIb			
Lydian Auxiliary Aug					IV# + V# + VI#		
Lydian Auxiliary Dim						IIIb + IV# + V#	
Lydian Auxiliary Diminished Blues							IIb + IIIb + IV + IV# + VIIb

Figure XVIII: Granitzio, 'Stalactite', progressive alterations of the Lydian scales.

The harmonic dispersion gradually involves the alterations of the first two Lydian scales: Lydian and Lydian Augmented (see Fig. XIX overleaf); dynamics decrease at the same pace. The second impact involves the successive Lydian Diminished and Lydian Flat 7 scales (Fig. XX). The third includes the remaining scales: Auxiliary Lydian Augmented, Lydian Auxiliary and Auxiliary Diminished Blues (Fig. XXI). Dispersion does not imply an immediate consummation of energy and material, so that the resonance of the notes involved in the first phase of the impact will dynamically decrease, but not disappear, during the second and third phases. This outgoing process, involving progressively all the notes of the modal scales, aiming to create a G pan-modal chord, is achieved through a gradual distribution of notes to violins, echoed by the violas' harmonics.

The outgoing concentric enlargement is also rhythmical, with a progressive dilation of the bars' time signatures: 3/4, 4/4, 5/4. The violins' harmonics, fading *al niente*, symbolise the complete dispersion of the modal scale alterations, forming the G pan-modal chords. Meanwhile, the remaining musical elements serve to characterise the formation of the stalactite and its C modal development.

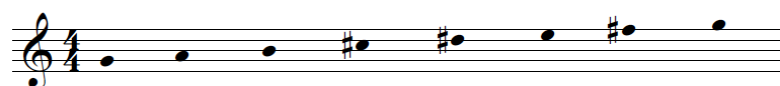


Figure XIX: Granitzio, 'Stalactite', first impact, G Lydian + G Lydian Augmented alterations.



Figure XX: Granitzio, 'Stalactite', second impact, G Lydian Diminished + Lydian Flat 7.

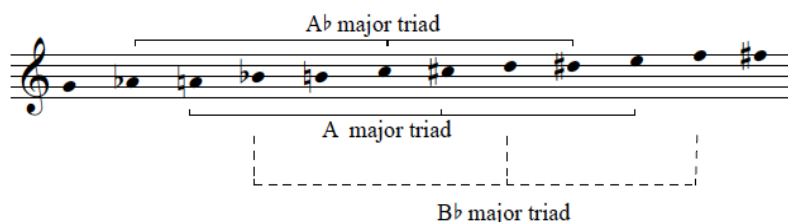


Figure XXI: Granitzio, 'Stalactite', third Impact, G Lydian Auxiliary Augmented + G Lydian Auxiliary Diminished + Lydian Auxiliary Diminished Blues.

Fig. XXII, overleaf, illustrates the orchestration of the Lydian alterations during the impacts of the first drop upon the ground:

	Impact I	Impact II		Impact III		Dispersion		
Time Signature	3/4	3/4	4/4	3/4	4/4	5/4	4/4	
Lydian scales	Lydian + L. Aug	L. Dim + L. Flat 7		L. Aux Aug + L. Aux Dim + L. Aux Dim blues				
Flute	E		D			E A		
Oboe	B		A		F	F C#		
Clarinet in B \flat	A G		A G		B \flat D	A \flat D		
Bass Clarinet	A		A		E \flat			
Bassoon	G		G		A \flat C	B \flat C		
Horn F	B F#		D F#		B E			
Trumpet	E		E		D F#			
Trombone	A		A		A C#			
Tuba	G		G		G			
Violins I	I – IV							
	VI – VIII						E	
	IX – XII						A	
	XIII - XVI						D	
Violins II	I – II						C	
	III – IV						F#	
	V – VI						C#	
	VII - VIII						G	
	IX – XI						A C# E	
	XII - XIV	C# D# F#	B \flat F		A \flat C E \flat			
Violas	I						E \flat	
	II						C	
	III						A \flat	
	IV				F	F		
	V				B \flat	B		
	VI		F#					
	VII		D#					
	VIII		C#					
Cellos	G							
Dbass	G							
		Impact I	Impact II	Impact III	Dispersion			

Figure XXII: Granitzio, ‘Stalactite’, table illustrating the impact of the first drop upon the ground.

Phase 4: Formation

On the assumption that stalactite elongation (theme) and enlargement (harmony/texture) are two paired – complementary – aspects of the same phenomenon, this subsection aims to analyse them separately for a better understanding of the compositional process.

Speleo-theme

As mentioned in the introduction (p. 2), the formation and development of stalactites consists of water dripping that, due to the force of gravity, carries within it calcium carbonate in progressively larger amounts. This continual ‘supply’ of material determines the speleothems’ elongation and enlargement. In order to achieve the aim of reproducing musically the same phenomenon, I focused on the following issues:

- How to represent the dripping;
- Defining the roles of orchestral instruments in representing a stalactite’s growth;
- How to characterise a progressive and constant downward transportation of an enlarging amount of material.

Concerning the first issue, Russell’s Tonal Gravity principle led me to conceive of a speleotheme formed by a dripping of descending fifths, using the notes of all C Lydian modal scales. Each thematic exposition starts from the Lydian note, F#, and involves progressively all notes of the Lydian scales by descending fifths, before arriving at the Lydian tonic. The main theme is repeated seven times: one for each Lydian scale.

Regarding the second issue: instruments are considered as drops, each one with its unique characteristics and quantity of timbral material. The flute reveals the theme first. Once its solo part is completed, the theme is played by another instrument and the flute

slowly changes its role, evolving into a kind of accompanying instrument. It becomes a part of the texture participating in the timbral development of 'Stalactite', coherently with the idea of a constant metamorphosis that involves every component of the speleothem(e)s.

Elongation and enlargement caused by the progressive and constant downward transportation of an increasing amount of material is achieved in three ways. Firstly, it involves progressively the scalar alterations from the Lydian scale to the Auxiliary Diminished Blues Scale, accentuating the idea of an 'outgoing' melody; secondly, it gradually stretches both the number of bars and time signatures. Thirdly, from the flute's exposition onwards, the theme is played by at least by two instruments, each playing (interpreting) the theme's note in its own individual way. The theme gets progressively denser, varying and combining different timbres.

Fig. XXIII below shows a manuscript scheme that outlines the structure of 'Stalactite' and the roles of each instrument relating to the theme's 'outgoing' development.

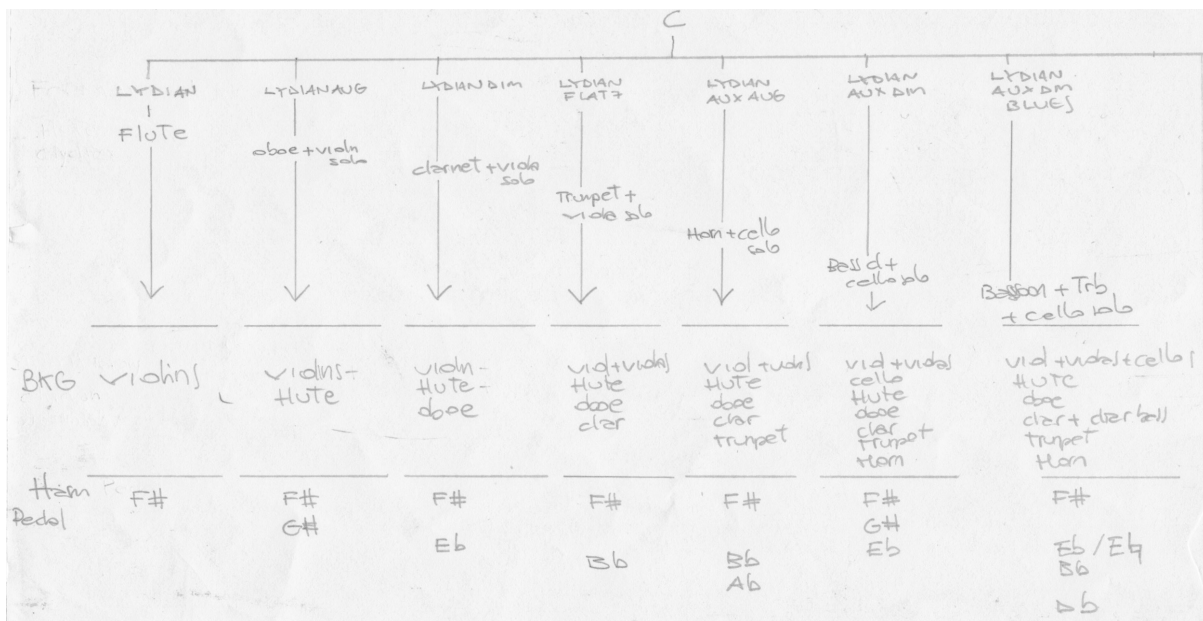


Figure XXIII: Granitzio, 'Stalactite', manuscript scheme outlining Stalactite's structure and the roles of every instrument relating to the thematic 'outgoing' development.

Speleo-texture/harmony

As mentioned in Chapter 3.2, after visiting Ingleton's White Scar cave my research aimed to contextualise in my music the issues related to an observation scale of natural phenomena. With the purpose of combining effectively the concepts of stasis and movement in the composition process, I focused on:

- How to allow the coexistence of stasis and movement in a given frame at the same time;
- How to develop harmony from the vertical dripping.

The first issue was approached from a technical and harmonic point of view. The thematic formation of 'Stalactite' is divided into seven steps, one for each Lydian scale. Every step is sustained by a harmony obtained by the superimposition of notes of the related scale, from the beginning until the entry of the next instrument. In order to counterbalance the harmonic stasis that characterises the frame of each Lydian scale fragment, and to give the impression of constant movement, the strings play the given note with continual slight variations. Notes are thus played:

- 1) From no vibrato to vibrato;
- 2) With *crescendo* and *diminuendo* dynamic variations;
- 3) With differing accents, thickening gradually in parallel with thematic development.

In order to combine stasis and movement in this slow harmonic developmental process, while during the seven-step thematic exposition some notes change (evolving into the next scale), the common notes between preceding and following Lydian scales do not. Keeping constant elements, while something else is changing, allowed me to represent, on the one hand, the harmonic common thread that links the 'before' with the 'after' (stasis) and, on

the other hand, to emphasise the idea of a metamorphosis that gradually involves all its constitutive elements (movement).

Regarding the second issue, as mentioned above, speleothems' elongation and enlargement is caused by a constant dripping of drops of water containing material eroded from the ceiling. For the purpose of this composition, that material is represented by the progressive alteration of one or more of the Lydian scale's notes, which drive the 'outgoing' melody. On the assumption that each new theme is characterised by the dripping of new alterations, the harmony changes each time a new alteration appears, according to its corresponding Lydian scale.

Harmonic texture increases gradually following the theme's development, including the whole string section and the other instruments that have completed their solo part, as discussed above. Once the seven-step theme is completed, the process is repeated once in *stringendo*, to symbolise further stalactite elongation. This transition converges in a theme that includes all seven scalar notes and culminates in a pan-modal chord, which introduces the last part of the first movement.

Phase 5: Dripping

This section represents on a large scale what 'Formation' depicts in small-scale detail. It is based on my hearing perception of my surroundings in several caves I visited, and it offers a perspective on all the speleothems of an active branch from a wider angle.

The composition of 'Stalactite' required the representation of both a liquid and rhythmical environment. According to the results of several acoustics experiments that I undertook inside caves, I chose to recreate the effect reached when I composed 'Deglaciation', the fourth movement of *Pangaea*, representing the water flow caused by melting glaciers. To achieve a liquid sound connotation, I exploited the Sounding Stones' full

potential as expressed by the hand friction technique. All Stones on stage play uncoordinatedly, at different rates and with different tempi, originating different pitches. At the end of the piece, gradually three of the four Stones are played with open jazz brushes. The passage of the jazz brushes over and among steles creates an effective percussive pitched sound, echoing water flowing/dripping. To emphasise the sound of the Stones and, at the same time, give a rhythmical connotation, the strings progressively play melodic cells, each one characterised by different accents. After the introduction of the helictites, the strings fade out, leading to the end of the movement.

Phase 6. Helictites

For unknown reasons, sometimes tiny, delicate stalactites seem to challenge the law of gravity. They may occur in spiral forms; occasionally they grow horizontally or bottom-up from the body of a stalactite. For this misaligned or unusual behaviour, helictites are also defined as 'eccentric' stalactites (Fig. XXIV). This ascending movement, analogous to that of stalagmites, preludes what happens in the second movement. A theme played by the first flute, developed by ascending fifths in two octaves, grows upwards, contrasting with the Tonal Gravity that dominates the whole movement.

Figure XXIV: 'Stalactite', Helictites stalactite.

5.3 'Stalagmite'

The second movement is dedicated to ascending speleothems. 'Stalagmites are a category of speleothems resulting from a point source of drip-water supersaturated with respect to calcite, and growing vertically upwards. In section, these stalagmites reveal a stratigraphy, which reflects the growth of the stalagmite as a function of time' (Kaufmann, Dreybrodt, 2004). The growth of stalagmites is influenced by several variables, including some theoretically predictable parameters such as 'temperature, precipitation, and carbon-dioxide concentration in the soil'; however, the variability of other parameters, such as the 'spatial and temporal', is not easily quantifiable (Baldini 2008).

The fascinating scientific facets of this process led me to focus mainly on three aspects:

- How to represent this bottom-up growth process;
- How to symbolise in music a continual flux of material whose growth parameters are subject to a variability that is often not quantifiable;
- How to spatialise the growth of 'Stalagmite', both on stage and in the score.

The following analysis will address these issues.

Vertically upward speleo-theme

'Stalagmite' is built on a cyclical repetition of an ascending fifths theme, which includes all the G-Lydian scale notes. It starts from a G pitch and its development incorporates a natural C note, representing part of the material dripping from the stalactite, which culminates in the Lydian note: C#, as shown below in Fig. XXV:

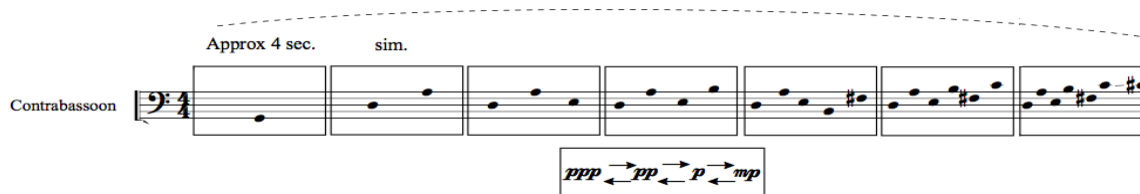


Figure XXV: 'Stalagmite', contrabassoon first sequence, proportional notation.

to approach 'Stalagmite' by focusing on using indeterminacy as a compositional element, exploiting improvisational potential as a tool to characterise uniquely every performance.

To achieve this aim I have considered the notes of the ascending theme to be the common material and musical parameters, such as note-lengths, dynamics and phrasing, as elements of indeterminacy, by which musicians play out their individual roles contributing to stalagmite growth. This means that, even if the path from G to C# is predetermined by a sequence of notes in a given frame, as the stalagmite grows up vertically, the way in which each path is completed varies according to the musical variables involved.

The score is provided with instructions aimed at encouraging a different performance of each sequence:

Time is fluctuating. The conductor should give only the first beat of each bar and the cues. Each note should be played freely with different lengths, excluding the initial G and the last C#. These should both be the longest in the temporal frame given by the conductor. Dynamics vary gradually from *pp* to *mp*, with distinctive combinations in every repetition. Phrasing varies freely, although the sequences should give a feeling of fluid organic growth from the bottom G to the top C#. C# is always very delicate and *sostenuto*, ending in *diminuendo*. All the sequences should be played with varying phrasing and note-lengths to achieve the aim of a motivic material in constant movement and development. When the conductor is giving the cue to more than one instrument at the same time, i.e. to a section, each player should always play the sequence individually and uncoordinated. Each player should play as a soloist, but should not be too prominent over the other instruments of the section. Every player plays his/her own individual fundamental role in the development of the stalagmite structure.

And:

The conductor will introduce single arm gestures to induce individual players to become more prominent. The extended arm gesture will indicate this and the withdrawal of the arm will indicate completion. When a whole section is involved, two arms will be used for the gesture.

The graphical approach chosen to symbolise this process was a proportional notation system, as shown in Fig. XXV above. This solution aims both to represent the indeterminacy and variability of the musical material in a given time frame, and to emphasise the individual role of every musician in the interpretation of those parameters.

Spatialisation: from score to stage

It is noteworthy that stalagmite growth involves inextricably both vertical and horizontal implications. This process is introduced partially at the very beginning of 'Stalactite', when the first drop impacts upon the cave floor, releasing and expanding its content on a horizontal plane. In a further stage, the accumulation of the material implies a vertical development. But, whereas in the first movement each thematic instrument plays its own part and then changes to converge within the body of the stalactite, in 'Stalagmite' each instrument keeps the same role. The stratification of the material accumulated by water dripping from an overhead stalactite forms a basis upon which the following drops will deposit their material. Thus every instrument constantly fulfils the same function, supporting, bottom-up, the stalagmite's upward development.

The theme starts in the contrabassoon and ends with the Sounding Stones. This instrumental layout has a double meaning. On a horizontal plane, the sequences follow the disposition of the instruments on stage, involving progressively and cyclically woodwind,

brass and strings, creating a centripetal spiral, as shown below in Fig. XXVII:

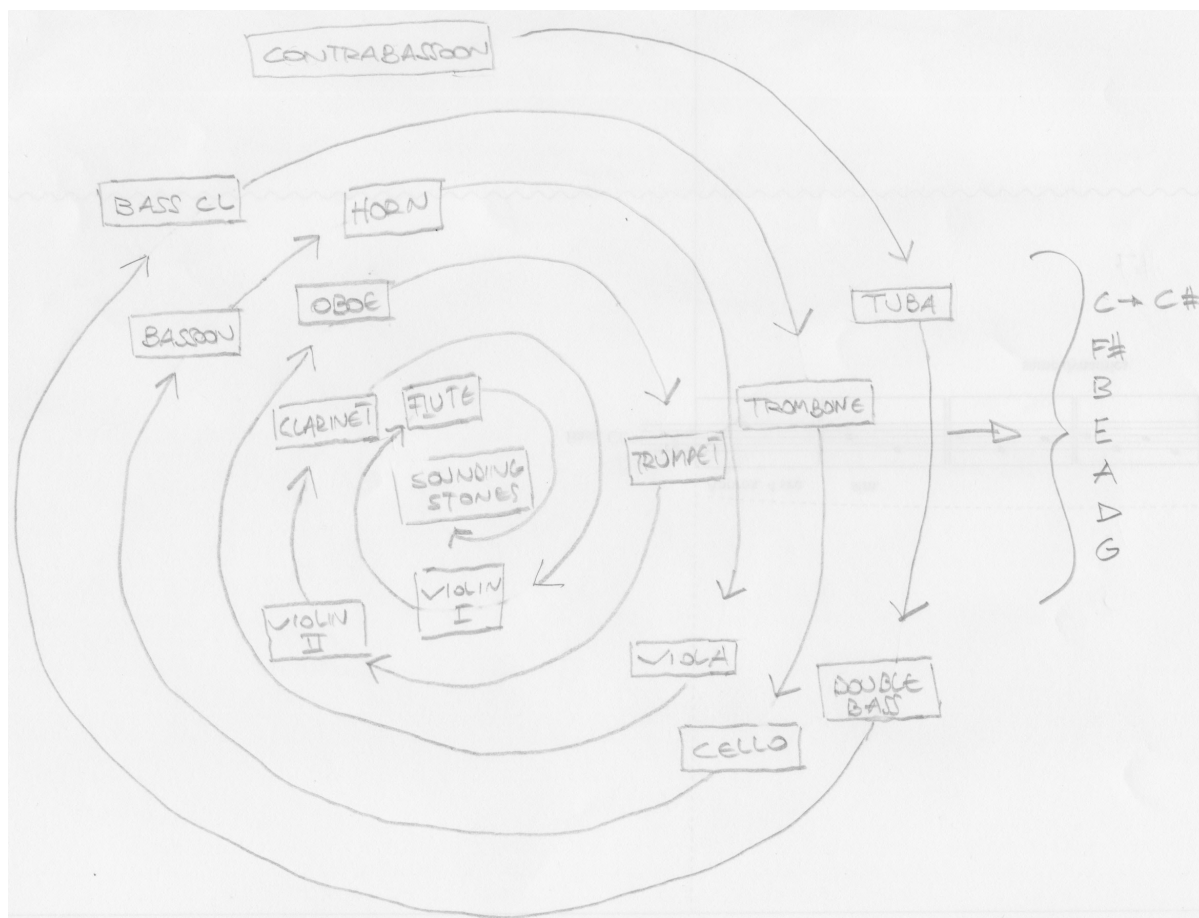


Figure XXVII: Granitzio, 'Stalagmite', manuscript scheme illustrating the horizontal spiral on stage.

On the vertical plane, the passage from woodwind, brass and strings to the Stones, involving different timbres at gradually ascending pitches, emulates an ascending spiral motion symbolising the material stratification of the stalagmite and its upward development (Fig. XXVIII).

Overleaf, Fig. XXIX illustrates a superb stalagmite from the Ardèche Caves in France.

Sounding Stone



Contrabassoon

Figure XXVIII: 'Stalagmite', vertical spiral on stage.

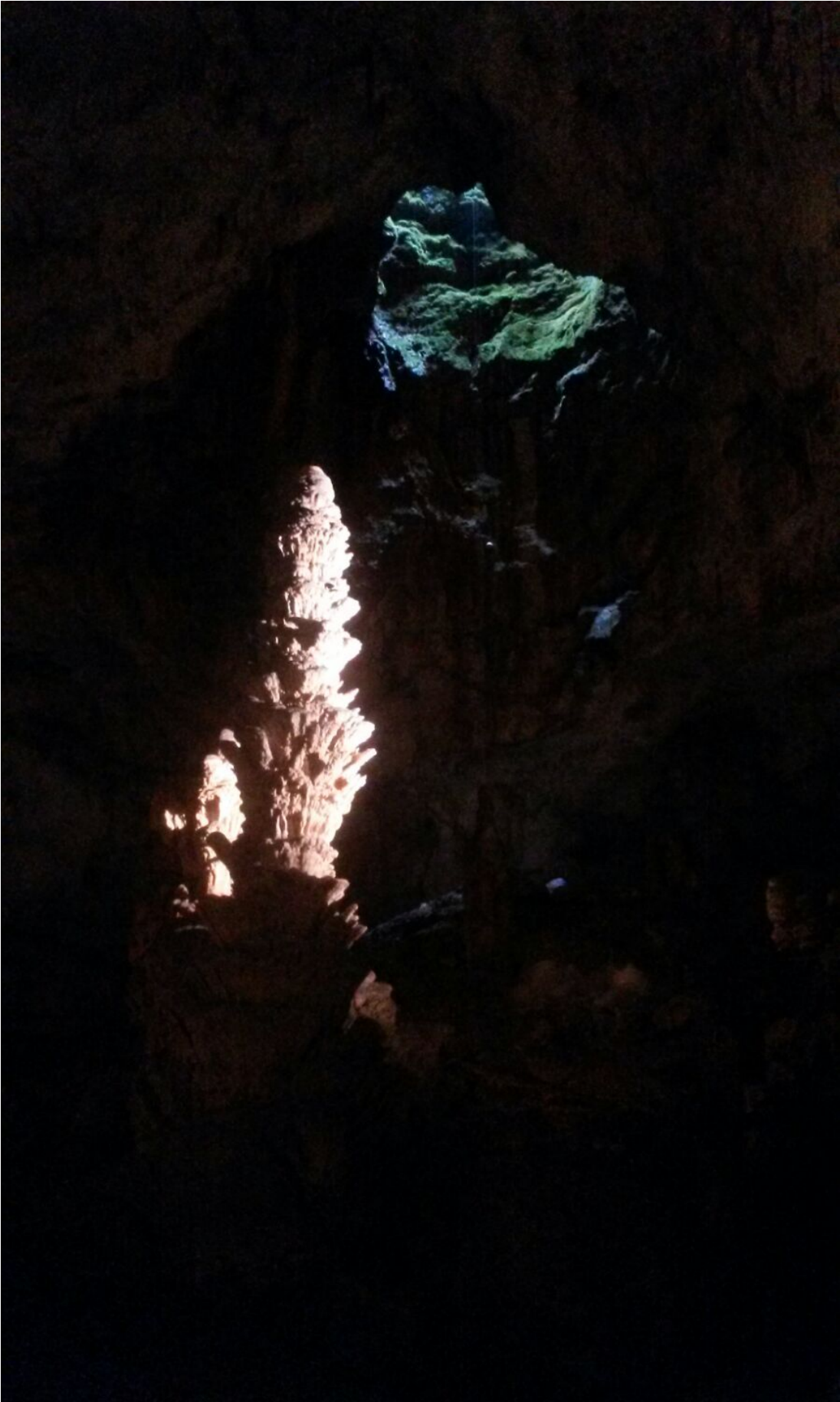


Figure XXIX, stalagmite, Ardèche Caves, France (photo: Granitzio).

5.4 'Joint'

'Don't be fooled by symmetry.'

(Sciola, personal communication, 14 September 2014)

This movement encompasses the philosophical and aesthetic principles that inspired the writing of 'Stalactite' and 'Stalagmite' and it brings together and reconciles their opposing dynamisms. The metamorphic concept, introduced in the first two movements, comes to a close in the third, permeating and characterising all speleothem(e) components. The growth of the two equal and opposite rock bodies culminates into a collision-contact that generates a 'column': a stand-alone active structure that embodies the components of both and reconciles them syncretically in a new balance.

Like the previous movements, 'Joint' is conceived as a unique flux of sound in constant evolution, but for the purpose of this analysis it will be divided into four phases:

- Sound origin
- Towards the contact – proximity
- Union
- Column

Phase 1. Sound origin

The view of sound origin offered in this section derives from the aesthetic premises for this work (see section 5.1), namely that the stones are the primal source of sound, encompassing an inner voice. Consistent with the purpose of fusing stasis and movement, this introductory section aims, on the one hand, to capture the transformation of sound, gradually crystallising each stage of the transition from unpitched to pitched sound; and on the other hand, it intends to preserve a sense of fluidity as though it would be possible to

change the human perception of geological phenomena observation and to contemplate, acoustically and visually, the formation of speleothems, as if in a time-lapse.

Inspired by what Sciola used to define as a gentle, non-percussive way to 'extract' the sound from the Stones, I chose to open the third movement by representing the sound of the dripping with the finger 'release pressure upstroke' technique. The natural vertical pattern, a drop in a percussive-like downward motion, is countered by a rhythmical/sounding event generated by a 'reverse percussion' upward stroke, as though the sound was physically extracted from the stone.

This is the first of six gradual steps (from unpitched to pitched full sound) designed to originate a sound from the Stones, gradually balancing their rhythmical and expressive potential, as indicated below:

- Release pressure finger upstroke

(The sound is generated by the detachment of the finger, which triggers the vibration of the stele.)

- Pizzicato

(This technique enables an increase in the sonorous component of the Stones, since finger pizzicato on the steles gives a clear definition of its pitches.)

- Tapping and tapping *alla tremolando*

(Sound evolves further when the passage of the fingertips becomes soft tapping on the Stone, creating a diffuse 'rain effect'.)

- Fingernails

(The passage of the fingernails on the top surface and on the sides of the Stones creates a dripping effect with both rhythmical and melodic elements.)

- Rubbing

(The sound obtained by rubbing with the palm of the hands on the Stones' top surface, first in circular motion and then vertically, creates an air-lift effect involving a greater number of columns, hence their pitches. It is conceived as a sort of natural evolution of the sound of the drops distributed in the chamber of the cave.)

- Friction

(This last stage of the Sounding Stones' evolution to a full sound is secured by the gradual passage from rubbing with light to medium pressure. A slight increase in hand pressure, in fact, triggers the Stones' resonance, fully exploiting their sonorous potential and completing the metamorphosis from percussive to pitched sound.)

During this evolutionary process, the movement of air caused by the sound generation symbolically reaches the other instruments of the orchestra, each of which, retracing the same steps as the Stones, evolves following the metamorphosis from percussion to sonorous sound according to its own specific timbral potential:

- Woodwind: breathing and clicking on keys, airy sound, overblowing, harmonics, full sound;
- Strings: tapping around F hole (just wood), tapping on strings near the bridge, tapping up and down on strings, *picchiettato* with the bow tip on the bridge,

tremolando with the left hand, pizzicato on harmonics glissando, *picchiettato* on harmonics glissando, full sound;

- Harp: tapping, circular rubbing;
- Piano: pedal, tapping on strings, glissando, pizzicato.

Once the sound formation is complete, stalactite and stalagmite move towards their contact.

Phase 2. Towards the contact – proximity

The path towards union is represented through an opposed motion, which involves both the descending movement of ‘Stalactite’ and the ascending movement of ‘Stalagmite’, with their respective C and G modal components.

What characterised the slow progress of the first two movements, in terms of their vertical and horizontal development, is here proposed in a shorter amount of time and space. This symbolises both the physical sharpening of the speleothems and the imminent contact between them. Each woodwind plays the ‘Stalactite’ C descending-fifth theme built on the seven Lydian scales, developing from Lydian to Lydian Auxiliary Diminished Blues, with a further progressive scalic amalgamation, as happened in the first movement during the first impact, as listed below:

- Lydian (L)
- Lydian Augmented (LA)
- Lydian Diminished (LD)
- Lydian Flat 7 (LF)
- Lydian Auxiliary Augmented (L Aux Aug)
- Lydian Auxiliary Diminished (L Aux Dim)

- Lydian Auxiliary Diminished Blues (L Aux Dim Blues)
- Lydian + Lydian Augmented (L + LA)
- Lydian Diminished + Lydian Flat 7 (LD + LF7)

Lydian Auxiliary Augmented + Lydian Auxiliary Diminished + Lydian Auxiliary Diminished Blues (L All)

Fig. XXX below offers an overview of the theme's development according to the 'outgoing'

Lydian notes:

C Lydian Scales	Scalic degrees	Theme
Lydian (L)	I II III IV# V VI VII	F# B E A D G (C)
Lydian Augmented (LA)	I II III IV# V# VI VII	F# B E A D G# (C)
Lydian Diminished (LD)	I II III ^b IV# V VI VII	F# B E ^b A D G (C)
Lydian Flat 7 (LF)	I II III IV# V VI VII	F# B ^b E A D G (C)
Lydian Auxiliary Augmented (L Aux Aug)	I II III IV# V# VI#	F# B E A# D G# (C)
Lydian Auxiliary Diminished (L Aux Dim)	I II III ^b IV IV# V# VI VII	F F# B E ^b A D G# (C)
Lydian Auxiliary Diminished Blues (L Aux Dim Blues)	I II ^b III ^b III IV# V VI VII ^b	F# B ^b E ^b E A D ^b G (C)
Lydian + Lydian Augmented (L + LA)	I II III IV# V VI# VI VII	F# B E A D G G# (C)
Lydian Diminished + Lydian Flat Seven (LD + LF)	I II III ^b III IV# V VI VII ^b VII	F# B ^b B E ^b E A D G (C)
Lydian Auxiliary Augmented + Lydian Auxiliary Diminished + Lydian Auxiliary Diminished Blues (LAA + LAD + LADB)	I II ^b II III ^b III IV IV# V V# VI VII ^b VII	F F# B ^b B E ^b E A D ^b D G G# (C)

Figure XXX, Granitzio, 'Joint', table overview of the theme's development according to the 'outgoing' Lydian

notes.

Figs. XXXI and XXXII illustrate different presentations of the C descending theme:

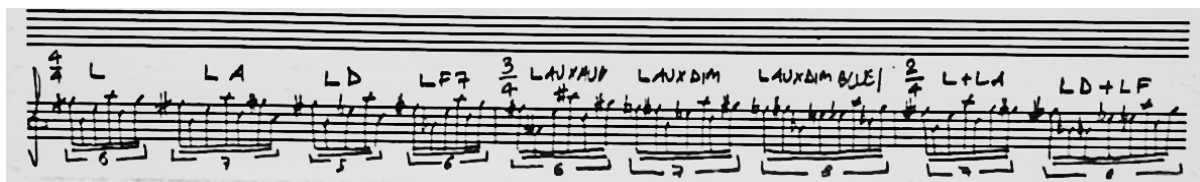


Figure XXXI: Granitzio, 'Joint', C descending theme – seven Lydian scales, plus first two combinations (L + LA and LD + LF7).

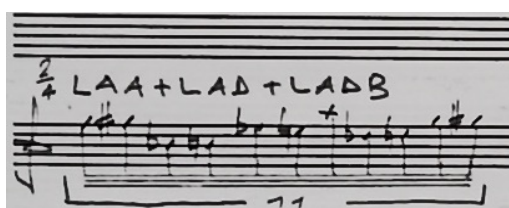


Figure XXXII: Granitzio, 'Joint', C descending theme – last combination (LAA + LAD + LADB).

Each string section plays the evolution of the G ascending-fifth theme of 'Stalagmite', built on the seven Lydian scales, so mirroring the 'Stalactite' process (Figs. XXXIII and XXXIV):



Figure XXXIII: Granitzio, 'Joint', G ascending theme – seven Lydian scales, plus first two combinations (L + LA and LD + LF7).



Figure XXXIV: Granitzio, 'Joint', G ascending theme – last combination (LAA + LAD + LADB).

This equal and opposite, almost mechanical, vertical motion creates a contrasting and vibrating pan-modal harmonic texture that reduces, metaphorically and physically, the

distance between the two antagonistic structures. The further proximity between stalactite and stalagmite is represented by a flute, cello and Stone trio interlude. This trio culminates in a brief Sounding Stones' duo, consisting of two chromatic contrary motion scales played by two bows, aimed at symbolising the ultimate drop that negates their distance.

Phase 3. Union

The stalactite and stalagmite opposed growth culminates in a collision between C and G pitches played by two small Tibetan cymbals and echoed by the two like-pitched steles of Sounding Stones played by bows. This contact between the two speleothems causes interpenetration as though the two rock bodies could continue their path, vibrating one into the other. Woodwind and strings swap their harmonic roles, so that strings play the C material and woodwinds the G material, characterising further the pan-modal harmony that typifies this portion of the composition. From the vibrating material denoting the conflict between 'Stalactite' and 'Stalagmite', both principal themes emerge, prevailing alternately one upon the other, and evolving following their Lydian development. The mutual material tends naturally to fuse and strings and woodwind each play an inversion of both C and G themes. This leads to the last stage of the movement.

Phase 4. Column

This last section represents the final and natural integration between stalactite and stalagmite. The resulting 'column' is a third unit, which integrates the components of both ascending and descending speleothems(e)s, and is represented by the sound of the Stones played by bows. This sound leads to the last movement and introduces the harmonic sound of the strings, a rich texture that fills the space of the chamber until the sound is absorbed by the Stones and released in the last part of movement.

5.5 'Before'

'This sound reminds me of something that I don't know.'

(7 year-old children from a class visiting

the Giardino Sonoro, 2011)

- 'Maestro Sciola, when did you discover the sound of the stones for the first time?'

- 'Before.'

- 'Before what?'

- 'Before... Do you remember the first time you met your mother?'

Sciola gave this same answer each time anyone asked that question. His simple, disorienting, answer is a perfect sum of his aesthetics, coherent with his view of the origin of sound. He thought that the sound of the stones, primal and primitive, was somehow fixed in our memory, even if it was not possible to remember when it had been heard for the first time.

'Before' is the final movement of *Speleothemes*; it is dedicated primarily to the sound of the Stones triggered by the friction of the palms of the hands, which was the first I heard of the Sounding Stones when I met Sciola. This movement seeks to recreate a cave environment and is inspired by my personal experiences in several caves in Italy, France and England. In order to compose this movement, I focused my research on two main aspects: sound perception and visual perception inside a cave.

1. Sound perception

As soon as visitors enter an active cave system, they immediately realise that echoes of dripping water surround them, yet it is hard to determine precisely the source of the sound.

To re-create a similar sound spatialisation, 'Before' requires additional Stones beyond those placed on stage, from six upwards. Stones should be placed around/amongst the audience: on the left side; on the right; at the back and one in the middle of the hall. The conductor will give initial cues following the order provided in the score: left, back, right, middle, recalling the spiral shape of the stalactites/stalagmites. This sound spatialisation aims to create both a centripetal and centrifugal sound flux, towards the centre and vice-versa, to surround the audience gradually, as will be discussed further. If the venue were set on different levels, and more Sounding Stones were available, they should be placed in equal numbers to the sides of the gallery. The image in Fig. XXXV (overleaf) shows an ideal spatialisation.

According to the instructions provided in the score, the players of the Sounding Stones on stage and in the hall will play a given number of times, gradually fading out, leaving the central one playing alone until fade out. If, due to its shape, it is not possible to place a Stone in the middle of the hall, the piece will end when Stones placed around the audience fade out.

The Sounding Stones should have a sufficient volume to cover the space of a theatre. If, during rehearsal, the conductor realises that their sound would not be perceived strongly enough, the Stones should be amplified according to the venue's shape and acoustics, preferably with both contact and overhead microphones. Amplification should be designed to recreate, as far as is possible, the spiral effect indicated in the score.

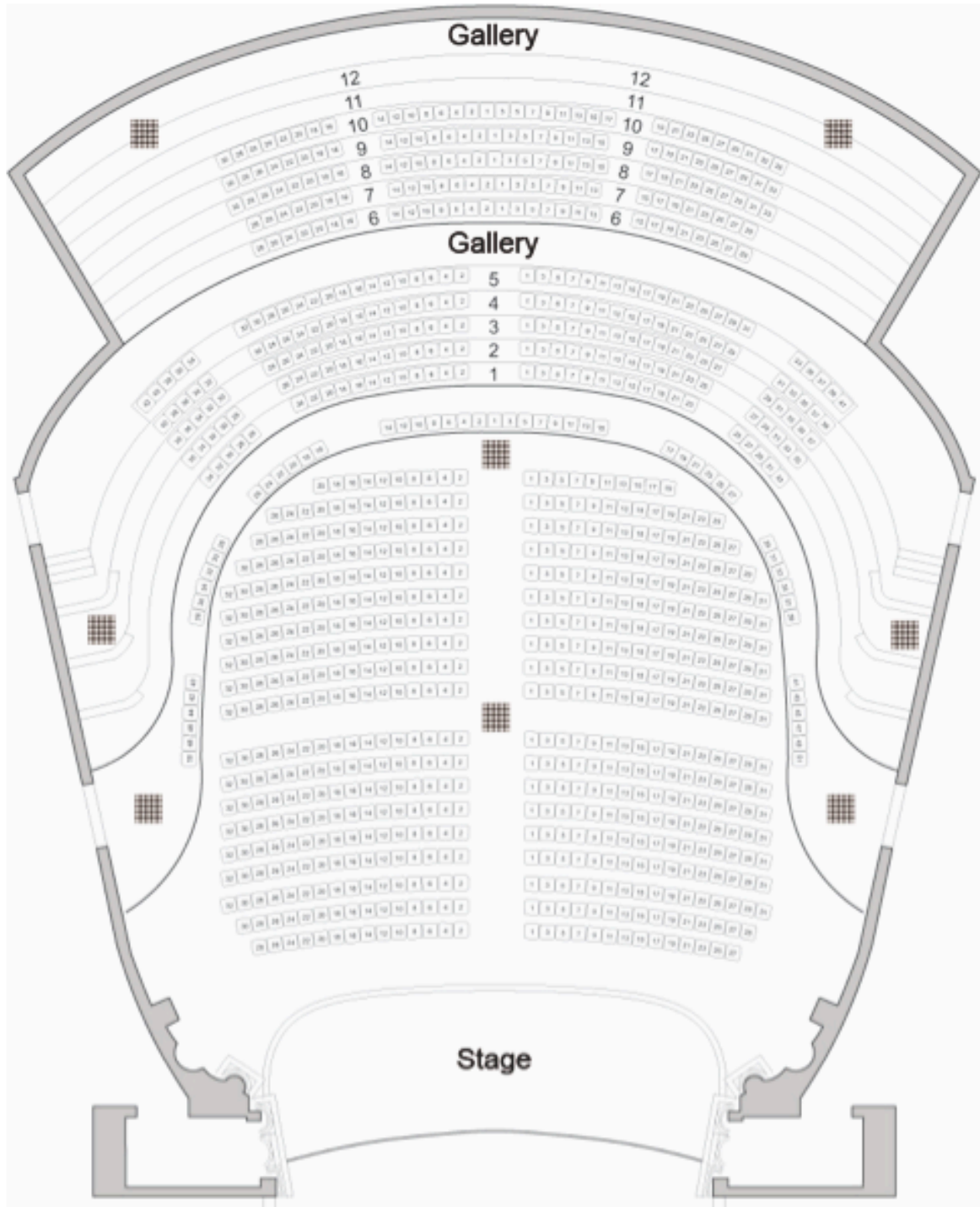


Figure XXXV: Granitzio, 'Before', ideal sound spatialisation in a large theatre, hall or gallery.

2. Visual perception

The second relevant aspect that characterises the exploration of caves is the lack of sunlight. Before taking a final decision on how to stage this last movement, I did several experiments both on myself and on other people, of which one of the most interesting took place inside the Tiscali Cave, in Sardinia (for an overview of the Tiscali Cave, see: <https://www.union.ic.ac.uk/rcc/caving/old/sardinia/sardinia07.php>).

I played some pre-recorded tracks of Sounding Stones inside the cave chamber, in a condition of complete visual deprivation, to test both my own and other people's perceptions. We shared our reactions straight after the experiments and, revealingly, we had very similar responses, focused upon an initial feeling of surprise and disorientation:

The experience of surprise means that an organism has failed to accurately anticipate possible future events. From a biological perspective, surprise is always bad, at least initially [...]. There are three different expressions of surprise and these expressions echo the primordial behaviours of *fight*, *flight* and *freeze*. Musical surprises are capable of initiating these responses, but responses themselves are short-lived because an ensuing appraisal ultimately judges the stimuli as nonthreatening. The appraisal response inhibits the full expression of fight, flight and freeze and also prevents the individual from becoming consciously aware of frisson, laughter or awe. Evidence in support of this account can be found in the various physiological responses associated with fight, flight and freeze that can also be observed among music listeners: piloerection, chills, changes of heart rate, laughter, gasping and breath-holding (Huron, 2007, p. 39).

Following this sense of surprise and subsequently of amazement, we experienced a sensation of being immersed in a liquid sound environment, which many have described as amniotic-like. This perception seemed somehow to be related to what Sciola had considered as a primitive sound, and explains the title of this movement.

With the aim of recreating an analogous environment, the fading out of the strings should be accompanied by the fading out of the lights, to reach an almost complete visual sensory deprivation. This visual condition would allow listeners to concentrate on hearing the sound texture around them. A direct, but dimmed, light upon the conductor should enable the Sounding Stones players to follow the final cues that bring the piece to its end. The main auditorium lights should be turned back on after the last Stone fades out, on the conductor's cue, indicating the very end of the piece and symbolising the end of the journey undertaken inside the listeners' unconscious memory.

The Sounding Stones placed in the main hall should be covered before the whole piece begins and then remain unnoticed for the first three movements; they should be uncovered and played upon the conductor's cue.

Structure

'Before' is articulated in two main parts. The first short part of the piece echoes the previous movement and introduces the sound of the Stones played by bows, which prevails in the second part by means of the hand friction technique. The sound stems initially from the double basses and gradually extends to cellos, violas and violins. All strings play harmonics, divided among specified instruments. Strings playing the same notes on the same string are asked to detune it by a quarter-tone, in order to create a microtonal spectrum similar to that of the Sounding Stones. The conductor gives progressive fade-in cues, first to the Sounding Stones' players positioned on stage and then to those positioned among the

audience. On the conductor's cue, the strings fade out. This crossfade between the strings and Stones represents metaphorically the imperceptible passage between conscious and unconscious memory. From that cue onwards, the Stones resonate *ad libitum*, until a final cue leads to a gradual end.

During the *tutti* of the Sounding Stones, the Stones' players will be free to accelerate or decelerate and vary the dynamics, in order to give a sense of fluctuation and to enhance the liquid perception mentioned above. Having deepened my awareness of the psychology of musical expectation, I was led to conclude that a duration between five and six minutes is a reasonable amount of time for playing the Stones before fading out slowly.

Chapter 6 – *The Fluid Mosaic*

What would Sounding Stones sound like if their steles could float on a liquid surface, shifting from their (un)fixed position to another one, moving continuously? *The Fluid Mosaic* stems from the idea of creating a mobile sonic image, a puzzle made by floating pieces which allows a perception of constant movement. Every stele/note leaves a trail of its shift while, slowly, its previous position and pitch is taken up by the following one, engaging a domino effect in a sort of perpetual motion. This composition, for cello sextet, viola sextet, violin sextet and Sounding Stones, aims to exploit the melodic potential of the Stones in order to seek a higher degree of integration between Stones and strings.

6.1 Conceptualisation and structure

The pitches of the Sounding Stones are not alterable, or ‘tune-able’, and they are not aligned with the equal temperament system. This apparent lack of precision, however, inspired a dialogue between strings and Stones based upon the flexible intonation of string instruments. Both the physical and metaphorical hiatus between the Stones and strings is overcome by means of glissando. Not only does this physically cover the microtonal distance between the starting- and arrival-points of every steles/note, but it also gives a sense of movement, rather as though the notes could float upon a liquid horizontal surface.

The whole piece is based upon a D-major scale played by strings, double-stopped in fifths. This scalar formation process begins in the cello section, then is subsequently developed by the viola section and the violin section, followed by the Stones played with the aid of bows and finally played with the hand-friction technique.

This composition consists of five formal sections: three involving the cello, viola and violin instrumental sections (rehearsal marks A, B); two involving, respectively, the Stones

played with the bow and with the hand-friction technique (rehearsal marks C, D). At a tempo marking of crotchet = c. 50, the piece commences in 3/4 metre and, after changing to 7/8 (bar 18), 4/4 (bar 22) and 9/8 (bar 24; rehearsal mark A), it arrives at the main 5/4 metre (bar 27). This progressive lengthening of metric units aims to mirror the trail of the steles movement upon the liquid surface, until the domino effect is finally reached and the mosaic image 'spins' at a 5/4 'revolution'. The effect is to simulate a never-ending spiral of movement, a growing tension created by seven notes repeated circularly, with tiny pitch imperfections that bring strings and Stones closer and closer.

In the last section, the mosaic comes to a conclusion by means of the Stones played by hands (bar 80, rehearsal mark D). The effect of these hand techniques on the top surface of the Stone is to create a harmonic-melodic ascending texture which incorporates and functionally completes the scalic formation process upon which the piece is based.

From a more interpretative stance, sound perception changes throughout the piece: at the beginning, the listener's attention is focused on the pitches. Slowly – as the number of instruments increase – there is a sort of zoom-out process, whereby the image gets bigger and details are less important. From a Neuroscientific perspective, once the mind is overloaded with too much musical information, there is no more space to analyse: the listener is caught in a web of sound. The most interesting aspect of this composition to me was to drive this listening process. Fittingly, there is an Italian contemporary composer, Salvatore Sciarrino, who defines this process as *Composizione dell'ascolto*: 'composing the listening'.

6.2 Techniques and notation

In this piece I have used two techniques to play the Stones. The first is bowing on an indicated stele with a given pitch. I have chosen Stones that include all seven D-major Ionian scale notes and have notated them on a five-line staff.

The Fluid Mosaic

The image shows a musical score for two staves, labeled 'So. St. VII' and 'So. St. VIII'. The music is in D major (one sharp) and common time (C). The score begins with a box containing the letter 'C'. The first staff (So. St. VII) has a whole rest followed by a half note G4, then a half note A4, and finally a half note B4. The second staff (So. St. VIII) has a whole rest followed by a half note F#4, then a half note G4, and finally a half note A4. The notation includes the instruction 'free bowing is accepted' under the first staff, and 'arco' above the notes in both staves. Dynamic markings 'mp' and 'sim.' are also present.

Figure XXXVI: Granitzio, *The Fluid Mosaic*, bowing notation.

In order to obtain the best result from bowing the steles and to enable a continuous and fluid sound, the 'free bowing is accepted' indication is given.

The second technique utilised is the hand-friction one, consisting of drawing the palm of the hands alternately from the top to the bottom of the Stone with medium pressure, to enhance the sympathetic resonance of the steles.

D Draw the palm of the hands alternately from the top to the bottom continuously

The diagram shows two hands, one above the other, with arrows pointing downwards from the palm side. The hands are positioned over a horizontal line representing the top of the stone. The arrows indicate the direction of movement from the top to the bottom of the stone. The hands are shown in an alternating sequence, with the top hand moving down and then the bottom hand moving down, and so on.

Figure XXXVII: Granitzio, *The Fluid Mosaic*, hands notation.

Across the formal repeated section from bar 87 to bar 91 a 'repeat ad libitum' indication is given, with the aim of reaching the climax of the Sounding Stones' sound and thus framing the image of the fluid mosaic. At bar 92, following the final cue, a *diminuendo* serves to bring the piece to its end.

Chapter 7 – Conclusion

Undoubtedly, the spark that ignited this research was the sound of the Stones; or rather, the disorienting reaction I had when for the first time I heard the Sounding Stones responding to the hands of Pinuccio Sciola. He was playing a limestone sculpture: evidence that my eyes could not easily believe. Where did that mesmerising sensation come from? My research journey had begun when I realised that, in order to provide an answer, I would need to re-appraise my experiences up to that point from a different perspective. Indeed, I would perhaps have to re-evaluate my previous work to focus on the links connecting fields of study that were, at first sight, quite distinct.

When I first approached the Sounding Stones, I simply wanted to understand why I felt so attracted by that sound. This led my research to follow two main paths: the first approaching the Sounding Stones as a musical instrument – a source of sound – and the second aimed at exploring the relationship between sound, emotion and the mind. The long conceptualising journey and the related compositional process led to a natural response to my initial research questions (see Introduction, 0.1) and ultimately opened up new perspectives and raised further questions.

7.1 Response to research questions

How can the timbral spectrum of the Sounding Stones enhance the language of composers?

As a musician-researcher my purpose was to focus on the sounds produced by the Sounding Stones, mastering the techniques required to play them and eventually discovering new ways to produce sound in order to achieve a full spectrum of timbre. Initially I approached the Stones as an ‘ordinary’ musical instrument, whose sound could have been used as a

source to vary, enrich and broaden my musical possibilities, simply operating within previous consolidated compositional schemes. This phase included firstly focusing on one individual technique and type of sound, then recording and overlaying multiple lines of different shades of that sound. Gradually I realised that, although playing the Stones with the bow allowed thinking in terms of melody and harmony, merely to compose 'ordinary' music would have frustrated the Sounding Stones' peculiarity. Aiming to define their musical identity, I focused progressively on the texture of the material the Stones were made of, namely limestone (watery sound) and basalt (earthy sound).

Once I had completed this phase, I had the tools to move to the next step, consisting of working with several Stones, mixing different sounds with a compositional approach based mainly upon the Stones' timbral properties in order to exploit their potential. This process culminated in the composition, and unexpectedly in the 'orchestration' – as in *Pangaea* – of the pieces for Stones included in my portfolio. This gradual methodological approach to the Sounding Stones not only enhanced my compositional language, as I discovered and mastered a new palette of sonic possibilities, but also traced the route towards the integration of the sound of the Stones with other traditional instruments.

Can the Sounding Stones successfully become part of an orchestral instrumentation?

When I approached the Soundings Stones for the very first time, instinctively I let myself be guided by Sciola, fascinated by his consideration of the Stones as a source of original and primal sound. Based on this assumption, I sought to build the sound of the other instruments around them, both metaphorically and functionally. This approach characterised the composition of the pieces for small ensemble and Stones. *Time Persistence* was inspired by the immanence of a sound that was chronologically antecedent, coeval and subsequent to the sound of the other instruments, whose role exists to affirm

the ephemeral nature of human life. In *Octahedron*, the Stone plays the physical role of a magnetic field of attraction that gives the other instruments a new order of priorities. These aesthetic principles evolved and converged in the conceptualisation of *Speleothemes*, where the sound of the Stones is the source from which the sound of the orchestra originates, as it happens in the third movement, or the sound that closes the composition, full circle, in the last movement.

It is noteworthy that, in composing *Speleothemes*, I became aware that I would probably have to abandon one of the most common hopes of a composer, namely that he/she would benefit from innumerable performances of his music. Although, on the one hand, working with the Stones opened up new ways of composing and thinking about music, on the other hand, I had to consider several practical issues, due to their physical nature and specific properties. The first issue was related to the fragility of the material they are made of because the cuts – especially into limestone – weaken the Stones' resilience. Each time a composition involves specific pitches, it has to be accepted that, if a Stone breaks, it will not be possible to replicate exactly the same sound. Secondly, Sciola sadly passed away before handing down his craft, and hence his knowledge of the techniques required to create new Sounding Stones.

I myself experienced the first issue on 26 August 2015, when accidentally I broke two Stones that I had been practising on for a full year. That day, thanks to Sciola, I realised – if not so peacefully – that even stones have a life expectancy. This episode led me to change my approach to the Stones, which initially had been confined to finding and using specific notes, as though working with conventional pitched percussion. From that moment onwards I paid more attention to the timbre itself and this led me to find alternative solutions, such as the one discussed above when I composed the trio of *Octahedron*.

Finally I realised that what had initially appeared to me as a frustrating limitation, instead emphasises and enriches the uniqueness of each performance, just as every Sounding Stone is a unique piece. In fact, whoever attends a performance of *Speleothemes* will be part of a one-off event, certainly not capable of exact repetition from an interpretative point of view, and probably, for the reasons given above, not even from a timbral perspective. Transcending those limits within my compositions, the Sounding Stones have not just been integrated with the orchestral instrumentation, thus enriching the timbral possibilities of the orchestra, they also play the role of soloist and leading instrument from which the sound of the orchestra originates, both metaphorically and physically.

Is it possible to integrate different influences as modal jazz and classical contemporary music, into an original and effective compositional outcome? And how can improvisation be integrated within this kind of compositional approach?

As mentioned in the Introduction, my background includes different influences and musical languages, encompassing classical, jazz and contemporary music. One of the aims of my doctoral research was to find a way to integrate them within an original and effective compositional outcome, including the use of improvisation. The way in which Takemitsu approached Russell's uses of modes offers a paradigmatic example of how it is possible to integrate methodically and successfully a jazz approach within a contemporary music setting. What interested me most was that the two worked on the same modal material from differing perspectives and intents: Russell aimed at enriching the improvisers' vocabulary and Takemitsu planned to escape from the equal-tempered scale system, but their common goal was to open up new ways and musical possibilities. I based my own

methodology upon this premise, in order to integrate different approaches with the purpose of writing a composition that could encompass them syncretically.

At a preliminary stage of the compositional process of *Speleothemes* my idea of improvisation was related to the use of modal scales as a source from which players could extract notes of choice or scalar fragments within a given structure. This could have led to a pan-modal improvised texture that reflected the Sounding Stone's unpredictable harmonic outcome when 'frictioned' with the palms of the hands. This initial approach, influenced by my jazz background and related strictly to the use of given modal notes/scales, changed when I realised that some parameters of speleothem growth were unpredictable and uncontrollable. Subsequently, I considered that improvisation should mirror that natural process and so introduced several variables relating to the lengths, dynamics and phrasing, to be freely chosen by players within a temporal frame set by the conductor.

With the aim of exploring this interesting aspect further, I also approached improvisation from the perspective of the psychology of musical expectation, deepening the neuroscientific relationship between sound, emotion and the mind, considering sound from a biological stance, and viewing the role of music in the evolution of humankind. Moreover, I undertook listening experiments in a variety of environments, including in caves, and with a variety of people – whether or not musicians – and have noted common responses to the sound of the Stones, described as an unexpected, amniotic-like sound. Ultimately, this confirmed that the Stones' sound is something unexpected and not immediately understandable (with interesting neuroscientific implications that will be pursued through the above mentioned NeuroStones project).

All the different aspects of this research on improvisation converged in the composition of *Speleothemes*, particularly in 'Stalagmite', focused mainly on

melodic/harmonic material, and in 'Before', focused on timbre in order to recreate a sort of metaphorical cave-sound-placenta.

7.2 Further reflections and future possibilities

This doctoral research has been an inspiring journey between different fields and places: I attended several Geosciences symposia in Iran, France, Italy and England; I studied aspects of the psychology of musical expectation and the neuroscientific relationships between sound, emotion and improvisation. I presented lectures on these topics both at Sichuan Conservatoire of Music in China and at the Department of Philosophy, Social, Human and Educational Sciences at the University of Perugia, in Italy, constantly inspired by the idea of an interdisciplinary approach to sound and music.

Historically, music has been defined as vocal or instrumental sounds combined in such a way as to produce beauty of form, harmony, and expression of emotion. As such it was confined to the Arts of the Quadrivium, together with Geometry, Arithmetic and Astronomy: scientific disciplines dealing with the measurement of proportions and the relationships between numbers, time and space. The process of organising and elaborating sound passes through, absorbs, permeates, touches, unites, involves – as cause or effect – many other scientific disciplines: physics and acoustics, with regard to the study of sonic origins and harmonic sounds; neurobiology and physiological psychology, in respect of the perception of musical messages and the role of hearing in human evolution, including synesthetic cognitive processes; anthropology, with regard to the role of sound in communication and language. It relates also to architecture in terms of compositional structure, and so on in other disciplines. The etymology of the word 'compose' comes from the Latin *cum-ponere*, which means literally to put together different elements to create a new harmonic system.

It has been rewarding to share my interdisciplinary view with scientific experts who have offered their perspectives and technical competence. As part of this, I have come to realise that their approach has many elements in common with musical composition. I have based my compositional approach on this methodology, gathering common elements from different disciplines and converging them within my compositional language to create a music aimed at representing a synthesis of them all.

The result of this research constitutes a starting point for me, since it has broadened my approach to music and composition, as well as having opened my eyes to new possibilities for interdisciplinary study. I am hopeful, too, that it will provide a path for other composers and musicians who, carrying on from this first step, would like to approach and develop further the musical potential of the Sounding Stones. Perhaps, once the NeuroStones project is complete, it will provide a scientific explanation of the process by which those sounds activate a synaptic response and switch on the mechanism that turns curiosity into passion and, as happened to me, create the desire to undertake research and discover.

Appendix 1 – *Stone Book* (USB drive)

Please consult the separate USB drive including the supporting videos showing all the techniques developed so far for playing the Sounding Stones.

Appendix 2 – Notation glossary

This Appendix aims to provide an overview of the notation created for the techniques developed for playing the Sounding Stones included in Appendix 1.

The techniques are divided in four categories, namely:

- Fingers
- Hands
- Bow
- Percussion

Each section of the Glossary is accompanied by a description of the techniques, its respective video in Appendix 1 and, where possible, by an indication of relevant bars within the scores. Given that the Sounding Stones allow composers or performers to play precise pitches or to exploit the timbral potential of their sound through indeterminate pitches, two different systems have been used. A conventional five-line staff, for precise pitches, and a one-line staff to notate indeterminate pitches and pitch variations, as shown below:



The first note should be played in the central stele of a row of choice, to be considered as a central reference-point. The staff represents graphically a dividing line that separates the notes above the line, which should be played on the right of the central stele, from notes below the line, which should be played on the left of the central stele, regardless of the pitch.

In order to obtain the best result from the Sounding Stones, players are recommended to warm their hands by mutual friction before playing, and to and wet their hands intermittently whilst playing using a wet warm towel. When possible it is also recommended to spread rosin dust on the palm of the hands, as it will increase the friction of the hands against the surface of the Stones, enhancing their resonance.

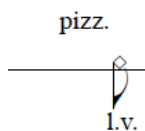
It should always be taken into consideration that usually the Stones do not resonate immediately, their sound built up after several frictions, when Stones warm up.

The Sounding Stones respond promptly to the bow. A generous use of rosin on the bow is recommended, as used by string players.

1 – Fingers

1 – Pizzicato:

Play pizzicato with one or more fingers on one or more steles; let the stele vibrate.

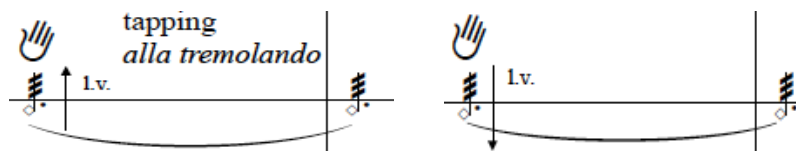


Speleothemes, 'Joint', bar 20

Video 01

2 – Tapping *alla tremolando*:

Tap the steles with the fingertips whilst slightly rotating the hands to produce a *tremolando* effect, moving across the Stone upwards or downwards; let the steles vibrate.



Speleothemes, 'Joint', bar 30

Video 02

3 – Tapping:

Use the fingertips similarly to keyboard playing, articulate with rapid movements, moving across the Stone upwards or downwards.

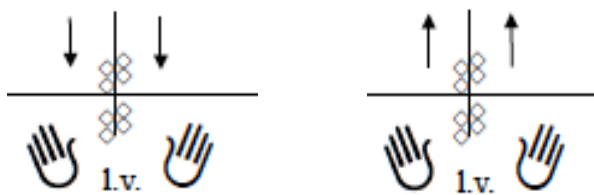


Speleothemes, 'Joint', bar 26

Video 03

4 – Fingernails upwards and downwards:

With hands facing backwards, draw the fingernails (four fingers, thumbs excluded) across the top surface of the Stone using the nails for articulation upwards and downwards; let it vibrate.

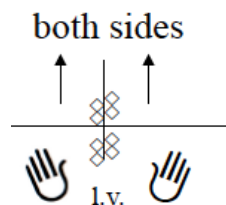


Speleothemes, 'Joint', bar 33

Video 04

5 – Fingernails on both sides of limestone harp:

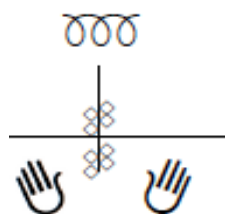
Draw the fingernails across both sides of the Stone, moving across it with forward horizontal articulations, with very light pressure; let it vibrate.



Video 05 (first gesture)

6 – Fingernails in a circle on both sides of limestone Harp:

Draw the fingernails across both sides of the Stone, in a circular motion, with very light pressure.



Speleothemes, 'Joint', bar 35

Video 05 (second gesture)

7 – Thumbnail on the edge of limestone Harp:

With hand facing backwards draw the thumbnail across the top surface of the Stone, from the bottom to the top.



Video 06

8 – Fingernail on the edge of limestone Harp:

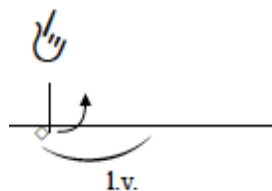
Draw the fingernail across the edge of the Harp, articulating nails downwards; let it vibrate.



Video 07

9 – Release pressure on single upstroke:

Press hard with one fingertip on one stele, then release the pressure suddenly to produce a tone; let it vibrate.

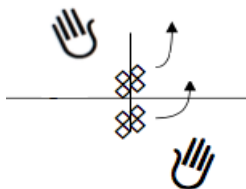


Speleothemes, 'Joint', bar 1

Videos 08 and 09 (Release pressure – augmented triad)

10 – Release pressure – multiple fingers:

Press hard with all fingers (thumbs excluded) on the steels, then release the pressure suddenly to produce a tone cluster and melodies.



Speleothemes, 'Joint', bar 16

Video 09 (Release pressure – multiple fingers – ascending melody)

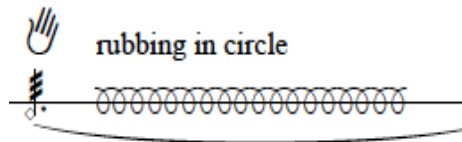
Video 10 (Release pressure – multiple fingers – ascending melody, Var. 1 *acciaccatura*)

Video 11 (Release pressure – multiple fingers – overhead view)

2 – Hands

1 – Rubbing with a circular motion:

Put one hand flat on the top surface of the Stone and move it across in a circular motion, with very light pressure.



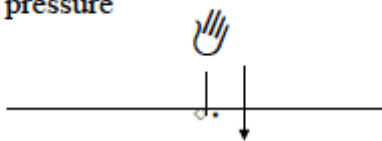
Speleothemes, 'Joint', bar 16

Video 01 (first gesture)

2 – Rubbing vertically:

Put one or both hands flat on the top surface of the Stone and move vertically from the top to the bottom, with very light pressure.

**to rubbing vertically
with light pressure**

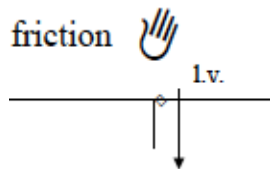


Speleothemes, 'Joint', bar 32

Video 01 (second gesture)

3 – Friction – single hand – vertical:

Put one hand flat on the top surface of the Stone, move it vertically from the top to the bottom, with medium pressure, to enhance the sympathetic resonance of the steles; let it vibrate.



Videos 02 and 03 (Friction single hand – top and bottom half of the Stone – separated)

4 – Friction – single hand – diagonal:

Put one hand flat on the top surface of the Stone, move it diagonally from the top to the bottom, with medium pressure, to enhance the sympathetic resonance of the steles; let it vibrate.



Video 04

5 – Friction – alternating hands:

Put both hands flat on the top surface of the Stone, alternating vertically from the top to the bottom, with medium pressure, to enhance the sympathetic resonance of the steles.



Speleothemes, 'Stalactite', bar 124; 'Before', bar 18

Videos 05, 06 and 07 (Alternating hands – fast)

6 – Friction on Harp – single hand/alternating hands:

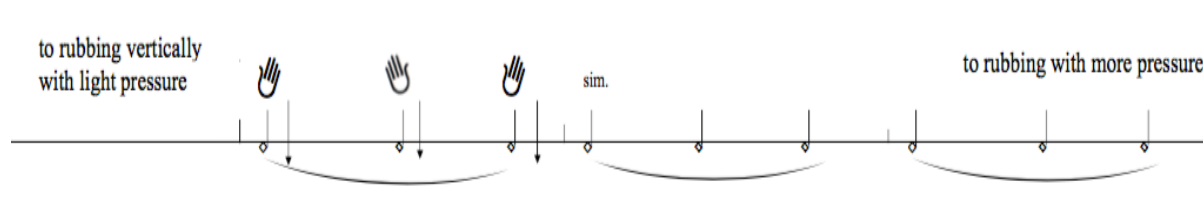
Put one or both hands flat on the top surface of the harp, move vertically alternating hands from the top to the bottom, with medium pressure, to enhance the sympathetic resonance of the steles.



Videos 08 and 09

7 – Rubbing with light to medium pressure:

Put both hands flat on the top surface of the Stone, move them vertically and alternatively from the top to the bottom, increasing from light to medium pressure, to enhance the sympathetic resonance of the steles.



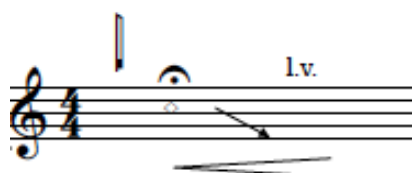
Video 10

3 – Bow

1 – Bowing on the edge:

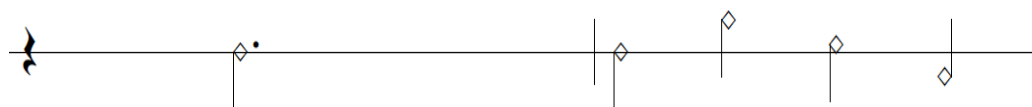
Draw the bow across one stele on the top surface of the Stone (any angle).

Notation for precise pitch, five-line staff:



Speleothemes, 'Stalactite', bar 1

Notation for indeterminate pitch, one-line staff:



Octahedron, bars 116–117

Video 01 (Bowing on the edge at 45° angle – very short)

Video 02 (Bowing on the edge at 45° angle – short)

Video 03 (Bowing on the edge at 30° angle – short)

Video 04 (Bowing on the edge at 45° angle – long)

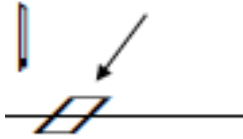
Video 05 (Bowing on the edge at 30° angle – close up – long)

Video 06 (Descending melody)

Video 07 (Melody C, D, B \flat , G).

2 – Diagonal bowing – downwards:

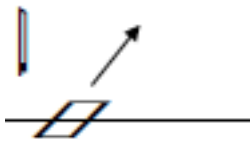
Hold the bow with both hands, one on the heel and one on the stick, drawing it across the top surface of the Stone, diagonally downwards.



Video 08

3 – Diagonal bowing – upwards:

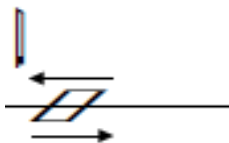
Draw the bow across the top surface of the Stone, diagonally upwards.



Video 09

4 – Articulation on both sides of the Stone:

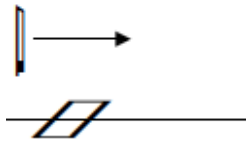
Hold the bow with both hands, one on the heel and one on the tip, draw it on the edge alternating the direction for each articulation and/or alternating sides.



Video 10

5 – Cross bowing:

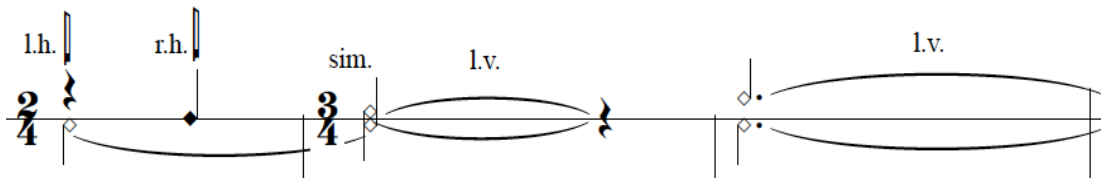
Draw the bow flat across a single row of steles on the top surface of the Stone.



Video 11

6 – Double Bowing:

Hold two bows and draw both on the edge of the Stone, on different steles.



Speleothemes, 'Joint', bars 56–58

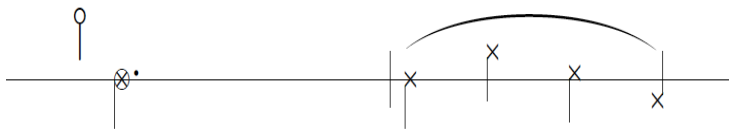
Video 12

4 – Percussion (Mallets, brushes, stone and wood)

1 – Soft mallet, single and multiple strokes:

Hit the stele/s very gently on the top surface of the Stone.

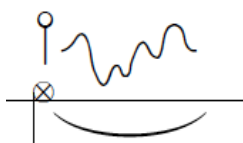
Notation for indeterminate pitch:



Videos 01 and 02

2 – Soft mallets, rubbing:

Rub a soft mallet on the top surface of the Stone, moving it from the top to the bottom or diagonally with right/left rapid articulations, with very light pressure.

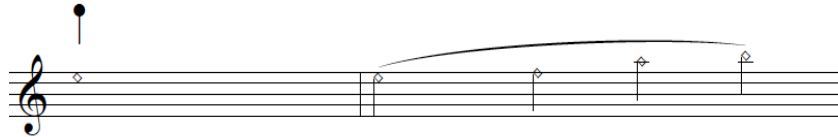


Video 03

3 – Hard mallets, single and multiple strokes:

Hit the stele/s very gently on the top surface of the Stone.

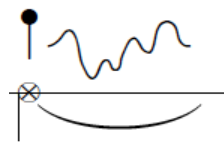
Notation for precise pitch, five-line staff:



Videos 04 and 05

4 – Hard mallets, rubbing:

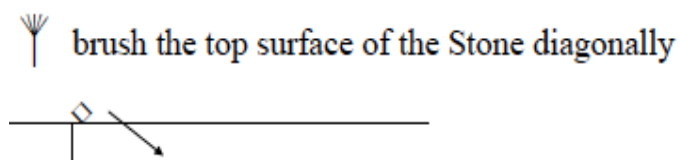
Rub a hard mallet on the top surface of the Stone, moving it from the top to the bottom or diagonally with right/left rapid articulations, with very light pressure.



Video 06

5 – Jazz brush, open or closed:


Brushing on the top surface of the Stone from the top to the bottom, single articulation.

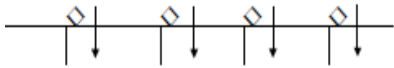


Video 07

6 – Jazz brush, open or closed:

Brushing on the top surface of the Stone from the top to the bottom, single or multiple articulations.

 brush the top surface of the Stone vertically



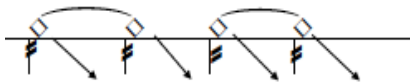
Speleothemes, 'Stalactite', bar 178

Video 08

7 – Jazz brush, open or closed:

Brushing on the top surface of the Stone diagonally, with rapid right/left articulation *alla tremolando*.

brush the top surface of the Stone diagonally
alla tremolando




Speleothemes, 'Stalactite', bar 182

Videos 08 and 09

8 – Jazz brush, open or closed:

Brushing on both sides of the Harp, alternating articulations with two brushes.

 brush both sides of the Stone
horizontally and vertically



Speleothemes, 'Stalactite', bar 185

Video 10

9 – Stone block:

Rub a stone block on the top edge of the Harp, from the bottom to the top with very light pressure.

- Rub the top surface of the Harp from the bottom to the top

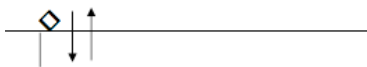


Video 11

10 – Stone block:

Rub a stone block on the top edge of the Stone, upwards/downwards *alla glissando* with very light pressure.

- Rub the top edge of the Harp upwards/downwards *alla glissando*

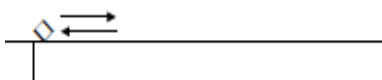


Video 12

11 – Stone block:

Rub a stone block on one side of a basalt Harp, articulating right/left *alla glissando* with very light pressure.

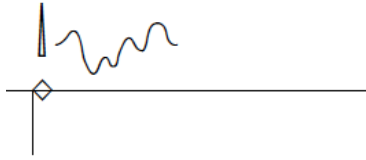
- Rub on one side of the Harp from right to left *alla glissando*



Video 13

12 – Wood block:

Rub a wood block on one side of the Harp, with a continuous and smooth movement, with light pressure.



Video 14

Appendix 3 – Selected compositions (USB drive)

Please consult the separate USB drive which includes the supporting recordings and a video of the following works from the composition portfolio:

Collection of works (as discussed in 4.11)

Heaven's Gate, composition for basalt and limestone

Erinni, composition for limestone

Stonature, composition for basalt and limestone

Heart of Stone, composition for basalt and limestone

Pangaea, composition for basalt and limestone

Time Persistence, composition for string quartet and Sounding Stones (audio and video)

Additional larger-scale work (as discussed in Chapter 6)

The Fluid Mosaic, composition for cello sextet, viola sextet, violin sextet and Sounding Stones

List of references and resources

(A) Primary sources

Selected scores

Berg, A. (1929) *Drei Orchesterstücke*. Vienna: Universal Edition.

Boulez, P. (1974/5) *Rituel in memoriam Bruno Maderna*. Vienna: Universal Edition.

Brown, E. (1972) *Times Five*. London: Universal Edition.

Halffter, C. (1971) *Planto por la victimas de la violencia*, ed. Universal Edition. New York.

Holliger, H. (1966/67) *Siebengesang für Oboe, Orchester, Singstimmen und Lautsprecher*.

Mainz: Ars Viva Verlag.

Holliger, H. (1970) *Pneuma* for wind, percussion, organ and radios. Mainz: Ars Viva Verlag.

Ligeti, G. (1961) *Atmosphères*. Vienna: Universal Edition.

Lutoslawski, W. (1979) *Novelette for Orchestra*. London: Chester Music.

Murail, T. (1982) *Désintégrations*. Paris: Henry Lemoine.

Ravel, M (1929) *Tableaux d'une Exposition*. New York: Editions Russes de Musique.

Roxburgh, E. (2010) *Concerto for Orchestra*. London: United Music Publishers.

Saariaho, K. (2002) *Orion for Orchestra*. London: Chester Music.

Saariaho, K. (2012) *Circle Map for Orchestra and Electronics*. London: Chester Music.

Stockhausen, K. (1957) *Nr. 5 Zeitmaße*. Vienna: Universal Edition.

Takemitsu, T. (1967) *The Dorian Horizon*. Tokyo: Ongaku No Tomo Sha.

Thorvaldsdottir, A. (2008) *Dreaming Flow*. Laugavegur: TÓNVERKAMIÐSTÖÐ Iceland Music

Information Centre.

Thorvaldsdottir, A. (2011) *Aeriality music for orchestra*, available at

<http://escholarship.org/uc/item/2h4228pb> [Last access 01/01/2017].

Music videos (available on Youtube)

Berg, A. (2014) *Drei Orchesterstücke*, available at

<https://www.youtube.com/watch?v=ZaZgG4-qLTU> [Last access 3/04/2017].

Boulez, P. (2014) *Rituel in memoriam Bruno Maderna*, available at

<https://www.youtube.com/watch?v=-k7EXNZqIUg> [Last access 3/04/2017].

Brown, E. (2013) *Times Five*, available at <https://www.youtube.com/watch?v=bZyKIPZLF28>

[Last access 3/04/2017].

Halffter, C. (2013) *Planto por la victimas de la violencia*, available at

<https://www.youtube.com/watch?v=q5eN2f4QjGw> [Last access 3/04/2017].

Holliger, H. (2016) *Pneuma*, available at https://www.youtube.com/watch?v=yYzU_qCkNLc

[Last access 3/04/2017].

Ligeti, G. (2012) *Atmosphères*, available at

<https://www.youtube.com/watch?v=vOIXgCaKhIQ> [Last access 3/04/2017].

Lutoslawski, W. (1979) *Novelette for Orchestra – part I*, available at

<https://www.youtube.com/watch?v=iOzBv4QS1Fw> [Last access 3/04/2017].

Lutoslawski, W. (1979) *Novelette for Orchestra – part II*, available at

<https://www.youtube.com/watch?v=DIOOuSGORAQ> [Last access 3/04/2017].

Maderna, B. (2011) *Giardino Religioso*, available at

<https://www.youtube.com/watch?v=vyWtkTsIN2c> [Last access 3/04/2017].

Murail, T. (2011) *Désintégrations – part I*, available at

<https://www.youtube.com/watch?v=qKbiNuXTVWs> [Last access 3/04/2017].

Murail, T. (2011) *Désintégrations – part II*, available at

<https://www.youtube.com/watch?v=DbR26tRLDHg> [Last access 3/04/2017]

Saariaho, K. (2012) *Orion – I Memento mori*, available at

<https://www.youtube.com/watch?v=UZO3n7KQUjA&list=PL9wnX-ft2pdW7pjh2pd7BEr2mi->

[rgx_F6](#) [Last access 3/04/2017].

Saariaho, K. (2012) *Orion – II Winter Sky*, available at

[https://www.youtube.com/watch?v=imGx7AgvTAA&index=2&list=PL9wnX-](https://www.youtube.com/watch?v=imGx7AgvTAA&index=2&list=PL9wnX-ft2pdW7pjh2pd7BEr2mi-rgx_F6)

[ft2pdW7pjh2pd7BEr2mi-rgx_F6](#) [Last access 3/04/2017].

Saariaho, K. (2012) *Orion – III Hunter*, available at

[https://www.youtube.com/watch?v=OJnQVieTcHA&index=3&list=PL9wnX-](https://www.youtube.com/watch?v=OJnQVieTcHA&index=3&list=PL9wnX-ft2pdW7pjh2pd7BEr2mi-rgx_F6)

[ft2pdW7pjh2pd7BEr2mi-rgx_F6](#) [Last access 3/04/2017].

Saariaho, K. (2013) *Circle Map*, available at

<https://www.youtube.com/watch?v=OPnNZydMYEI> [Last access 3/04/2017].

Scelsi, G. (2015) *Quattro pezzi per orchestra*, available at

<https://www.youtube.com/watch?v=MfTjz6emd7c> [Last access 3/04/2017].

Takemitsu, T. (2012) *The Dorian Horizon*, available at

<https://www.youtube.com/watch?v=DuzFWIUAgjM> [Last access 3/04/2017].

Thorvaldsdottir, A. (2011) *Dreaming*, available at

<https://www.youtube.com/watch?v=P3kMiSP0NV0> [Last access 3/04/2017].

Thorvaldsdottir, A. (2011) *Aeriality*, available at

<https://www.youtube.com/watch?v=O-iil3YYp5E> [Last access 3/04/2017].

Selected CD recordings

Davis, M. (1959) *Kind of Blue*, rec. New York, Columbia 30th Street Studio, 22 April, 1959.

Columbia LP CS 8163.

Davis, M. (2001) *Milestones*, rec. New York, Columbia 30th Street Studio, 4 February, 1958.

Columbia LP CL 1193.

Davis, M. & Evans, G (1999) *Sketches of Spain*, rec. New York, Columbia 30th Street Studio November 1959/March 1960. Columbia/Sony Music Distribution CD 65142.

Debussy, C. (1995) *Orchestral Works*, New Philharmonia Orchestra, Cleveland Orchestra, Pierre Boulez (cond.). London: Sony CD 68327.

Debussy, C. Ravel, M. Fauré, G. (1996) *Debussy, Ravel: String Quartets; Fauré: Piano Trio*, Tokyo Quartet. London: Sony CD 62413.

Granitzio, A. (2014) *Heart of Stone – Cuore di Pietra*. San Sperate: No Arte CD 12014.

Ravel, M. (2002). *The Complete Orchestral Works*, London Symphony Orchestra, Claudio Abbado (cond.). London: Deutsche Grammophon CD 469 354-2.

Russell, G. (1978) *George Russell's New York Band*, rec. Estrad, Sodertalje, Sweden, March 1977 and New York City, August, 1978. Soul Note CD 121 039-2.

Russell, G. (1981) *Vertical Form VI*, rec. Estrad, Sodertalje, Sweden, March 1977. Soul Note CD 121 019-2.

Russell, G. (1983) *Listen to the Silence*, rec. Kongsberg, Norway, June 1971. Soul Note CD 121024-2.

Russell, G. (1983) *The Essence of George Russell*, rec. Stockholm, Sweden 1966–1967. Soul Note, CD 121 044-2.

Russell, G. (1985) *George Russell's Sextet, Electronic Sonata for souls loved by nature*, rec. Milan 1980. Soul Note CD 121 009-2.

Takemitsu, T. (2002) *Complete Piano Works*, Kanako Abe, piano. Mandala, Man-5047

Takemitsu, T. (1998) *Orchestral Works IV: Coral Island, The Dorian Horizon*. Tokyo Metropolitan Symphony Orchestra, Yuzo Toyama (cond.). Denon – CO-18073.

Takemitsu, T. (2006) *Orchestral Works*, Bournemouth Symphony Orchestra, Marin Alsop (cond.), rec. Concert Hall, Lighthouse, Poole, England, 2005. Naxos 8.557760.

(B) Secondary sources

Bibliography

Adler, S. (2008) *The Study of Orchestration*. 3rd edition. New York/London: W.W. Norton & Company Inc.

Alexander, P.L. (2008) *How Ravel Orchestrated Mother Goose Suite*. Petersburg, VA: Alexander Publishing.

Allaby, M. (2008) 'Pangaea', *Oxford Dictionary of Earth Science*. Oxford: University Press, p. 418.

Baldini, J. (2008) 'Very High-frequency and Seasonal Cave Atmosphere PCO₂ Variability: Implications for Stalagmite Growth and Oxygen Isotope-based Paleoclimate Records'. *Earth and Planetary Science Letters*. Vol. 272, Nos. 1–2, p. 118–29. Available online at <http://www.sciencedirect.com/science/article/pii/S0012821X08002690> [Accessed on 03/04/2017]

Blackburn, S. (2016) 'Erinyes', *The Oxford Dictionary of Philosophy*, in *Oxford Reference Online*. Available at <http://www.oxfordreference.com/view/10.1093/oi/authority.20110803095756601> [Accessed 03/04/2017].

Blades, J. (2001) 'Lithophone', *Grove Music Online*, in *Oxford Music Online*. Available at <http://oxfordindex.oup.com/view/10.1093/gmo/9781561592630.article.16776> [Accessed 03/04/2017].

Borio, G. & Galliano, L. (2009) *Music Facing Up to Silence – Writings on Tōru Takemitsu*. Pavia: Pavia University Press.

Brindle, R. S. (1991) *Contemporary Percussion*. Oxford: Oxford University Press.

Brognoli, R. (2013) *Il Mondo scolpito: ispirazione, materia, sonorità nell'arte di Pinuccio Sciola*. Milano: Università Cattolica del Sacro Cuore, Facoltà di Lettere e Filosofia.

- Burt, P. (2002) 'Takemitsu and the Lydian Chromatic Concept of George Russell'. *Contemporary Music Review*, Vol. 21, No. 4, p. 73–109. Available at <http://www.tandfonline.com/doi/abs/10.1080/07494460216666#.UhJn3OCv4V8> [accessed 03/04/2017].
- Cage, J. (1942) 'Personal History', in File 1942, John Cage Archive, Northwestern University Music Library, Evanston, Illinois.
- Cage, J. (1961) 'The Future of Music: Credo', in J. Cage and K. Gann (2011). *Silence: Lectures and Writings*. Middletown, Conn.: Wesleyan University Press.
- Copley, A. L., Varèse, E. (1968) 'Edgard Varèse on Music and Art: A Conversation between Varèse and A. L. Copley'. *Leonardo*, Vol. 1, No. 2 (Apr., 1968). The MIT Press, p. 187–95. Available at <http://www.jstor.org/stable/1571960> [Accessed on 21/03/2018]
- Davis, F. (1986) *In the Moment*. Oxford: Oxford University Press.
- Dean, R. T. (1989) *Creative Improvisation: Jazz, Contemporary music, and Beyond: How to develop Techniques of Improvisation for any Musical Context*. Milton Keynes and Philadelphia: Open University Press.
- Falk, D. (2009) *Finding Our Tongues, Mothers, Infants & the Origins of Language*. New York, NY: Basic Books.
- Favaro, R. (2011) *Suoni e Sculture: le pietre e le città sonore di Pinuccio Sciola*. Cagliari: Arkadia.
- Frisia, S. and Woodhead, J.D. (2012) 'Stalactites and Stalagmites', in *Encyclopedia of Caves*, p. 805–10. Available online at <http://www.sciencedirect.com/science/article/pii/B978012383832200116X> [Accessed 03/04/2017].
- Gann, K. (2010) *No Such Thing as Silence: John Cage's 4'33"*. New Haven, Conn.: Yale University Press, p. 25.

Garau, M. (2012) *La Città Sonora: composizione per Pietre Sonore di Pinuccio Sciola e dispositivi elettroacustici*. Conservatorio di Musica Pierluigi da Palestrina, Cagliari.

Gimore, B (2003) 'The Climate since Harry Partch'. *Contemporary Music Review*, Vol. 22, Nos. 1–2, p. 15–33. Available at

<http://repository.falmouth.ac.uk/475/1/The%20climate%20since%20Harry%20Partch.pdf>
[Accessed 03/04/2017].

Gunn, J. (2004) *Encyclopedia of Caves and Karst Science*. New York: Fitzroy Dearborn.

Howat, R. (1986) *Debussy in Proportion – A Musical Analysis*. Cambridge: Cambridge University Press.

Howatson, M.C. (2013) 'Harmony of the Spheres', in *The Oxford Companion to Classical Literature Online*. Available at

<http://www.oxfordreference.com/view/10.1093/acref/9780199548545.001.0001/acref-9780199548545-e-1421#> [Accessed 03/04/2017].

Hornbostel, E. M. and Sachs, C. (1914) 'Systematik der Musikinstrumente', *Zeitschrift für Ethnologie*, trans. repr. (1992) in H. Myers (ed.), *Ethnomusicology: An Introduction*. London: Macmillan, p. 444–61.

Kassel, R. (2001) 'Partch, Harry', *Grove Music Online*, in *Oxford Music Online*. Available at <http://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000020967> [Accessed 07/04/2018].

Kaufmann, G. and Dreybrodt, W. (2004) 'Stalagmite Growth and Palaeo-Climate: An Inverse Approach'. *Earth and Planetary Science Letters*. Vol. 224, Nos. 3–4, p. 529–45. Available at <http://adsabs.harvard.edu/abs/2004E%26PSL.224..529K> [Accessed 03/04/2017].

Kennedy, M. and J.B. (2013) 'Improvisation', *The Concise Oxford Dictionary of Music*, in *Oxford Music Online*. Available at

<http://www.oxfordreference.com/view/10.1093/oi/authority.20110803095959637>

[Accessed 03/04/2017].

Kepler, J. (1619) *The Harmony of the World*. Reprint, Philadelphia: American Philosophical Society, 1997.

Kornas-Biela D. (2014) 'Pre and Perinatal Auditory Experiences and their Importance in the Development of the Child', in *Developing Language Competence of People with Hearing and Speech Disorders*. Lublin: Wydawnictwo KUL, p. 7–26.

Libin, L. (2015) 'Found Instruments', *The Grove Dictionary of Musical Instruments*. 2nd edition. *Oxford Music Online*. Available at <http://www.oxfordreference.com/view/10.1093/acref/9780199743391.001.0001/acref-9780199743391-e-2450> [Accessed 26/03/2018].

Ligeti, G. (1965) 'Metamorphoses of Musical Form'. *Die Reihe*, Vol. 7, p. 5–19.

Lo Schiavo, F. (2013) 'The Bronze Age in Sardinia', in Fokkens and Harding (eds.), *The Oxford Handbook of the European Bronze Age*. Oxford: Oxford University Press, p. 668–91.

Luzzi, M. (1980) *Uomini e avanguardie jazz*. Milano: Gammalibri.

Mithen, S. (2007) *The Singing Neanderthals: The Origins of Music, Language, Mind and Body*. Cambridge, MA: Harvard University Press.

Monelle, R. (1992) *Linguistics and Semiotics in Music*. Contemporary Music Studies. Vol. 5. London: Routledge.

Montagu, J. (2017) 'How Music and Instruments Began: A Brief Overview of the Origin and Entire Development of Music, from Its Earliest Stages'. Available at <https://www.frontiersin.org/articles/10.3389/fsoc.2017.00008/full> [Accessed 26/03/2018].

Morgan, R. (1994). 'A New Musical Reality: Futurism, Modernism, and *The Art of Noises*', in *A Special Issue on Marinetti and the Italian Futurists*. Baltimore, Md: Johns Hopkins University Press, p. 141.

Pasqualotto, G. (2009) *Nature and Art of Silence in Tōru Takemitsu – Music Facing Up to*

Silence. Writings on Tōru Takemitsu. Pavia: Pavia University Press.

Persichetti, V. (1961) *Twentieth Century Harmony: Creative Aspects and Practice.* New York; London: Norton & Co.

Piston, W. (1978) *Orchestration.* London: Victor Gollancz.

Polillo, A. (1998) *Jazz.* Milano: Mondadori.

Reznikoff, I. (2010) *La Dimension sonore des grottes paléolithiques et des rochers à peintures. L'art pléistocène dans le monde,* Actes du Congrès IFRAO sur l'art pléistocène dans le monde. Tarascon-sur-Ariège, p. 45–56.

Reznikoff, I. (2010) *L'Existence de signes sonores et leurs significations dans les grottes paléolithiques. L'art pléistocène dans le monde,* Actes du Congrès IFRAO sur l'art pléistocène dans le monde. Tarascon-sur-Ariège, p. 1741–47.

Roxburgh, E. (2014) *Conducting for a New Era.* Woodbridge: The Boydell Press.

Russell, G. (2001) *Lydian Chromatic Concept of Tonal Organization – The Art and the Science of Tonal Gravity.* 4th edition. Massachusetts: Concept Publishing Company.

Russolo, L. Filliou, R. and Pratella, F.B (1913). *The Art of Noise: Futurist Manifesto.* New York: Something Else Press, 1967.

Saggini, V. (2013) 'Intonarumori'. Available at

<http://www.thereminvox.com/article/articleview/116/1/31/index.html>

[Accessed 26/03/2018].

Schwarz, K. R. (1996) *Minimalists.* London: Phaidon.

Schmutzler, R. (1962) *Art nouveau.* New York: Abrams, Inc.

Short, Martin B., et al. (2005) 'Stalactite Growth as a Free-boundary Problem: A Geometric Law and its Platonic Ideal'. *Physical Review Letters.* Available at <http://prl.aps.org/abstract/PRL/v94/i1/e018501> [Accessed 02/04/2017].

Stennott, S. (2004) *Encyclopaedia of 20th Century Architecture.* Vol 2. New York: Fitzroy

Dearborn.

Stock, J. (2014) 'The Art of the Commonplace: Found Sounds in Compositional Practice'. PhD diss., City University of New York. CUNY Academic Works. Available at http://academicworks.cuny.edu/gc_etds/390 [Accessed 02/03/2017].

Stone, K. (1980) *Music Notation in the Twentieth Century: A Practical Guidebook*. New York: WW Norton & Company Incorporated.

Takemitsu, T. (1987) *Yume to kazu*. Tokyo: Libroport.

Takemitsu, T. (1995) *Confronting Silence. Selected Writings*. Berkeley: Fallen Leaf Press.

Thorn, B. (2002) 'Luigi Russolo in Music of the Twentieth Century Avant-garde', in L. Sitsky (ed.), *Music of the Twentieth-Century Avant-Garde: A Biocritical Sourcebook*, p. 45. Westport, Conn: Greenwood Press.

Toop, R. (2002) 'Takemitsu and the Avant-garde', in Hugh de Ferranti & Yoko Narazaki (eds.), *A Way a Lone: Writings on Toru Takemitsu*, pp. 2–8. Tokyo: Academia Music.

Tymoczko, D. (1997) 'The Consecutive-Semitone Constraint on Scalar Structure: A Link between Impressionism and Jazz'. *Integral*, Vol. 11, p. 135–79. Available at <http://www.jstor.org/stable/40213975> [accessed 03/03/2017].

Tymoczko, D. (2004) 'Scale Network and Debussy'. *Journal of Music Theory*. Vol. 48, No. 2, pp. 219–94. Available at <http://www.jstor.org/stable/27639383> [Accessed 03/03/2017].

Tymoczko, D. (2011) *A Geometry of Music: Harmony and Counterpoint in the Extended Common Practice*. New York: Oxford University Press.

Valle, A. (2002) *La notazione musicale contemporanea – aspetti semiotici ed estetici*. Torino: De sono.

Viridis, C., Favaro, R. (2012) *Le colonne infinite, omaggio a Gaudí, sculture di Pinuccio Sciola*. Cagliari: Cucc.

Viridis, C., Favaro, R. (2013) *Ascoltare la pietra, Sculture di Pinuccio Sciola*. Roma: Gangemi.

Wen-Chung, C. (1966) 'Varèse: A Sketch of the Man and His Music'. *The Musical Quarterly*, Vol. 52, No. 2, p. 151–70. Available at <http://www.jstor.org/stable/741034> [Accessed 27/03/2018].

Wen-Chung, C., Varèse, E. (1966) 'The Liberation of Sound'. *Perspectives of New Music*, Vol. 5, No. 1, p. 11–19. Available at <http://www.jstor.org/stable/832385> [Accessed 27/03/2018].

Williams, M. B. (1998) 'John Cage: Professor, Maestro, Percussionist, Composer'. Available at <http://bmichaelwilliams.com/wp-content/uploads/2013/02/PNCagePMPC.pdf> [Accessed 27/3/2018].